THE IRON TRADE REVIEW

VOLUME XXVIII. CLEVELAND, O. NOVEMBER 28, 1895. CHICAGO, ILL. NUMBER 48.

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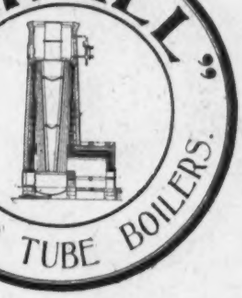

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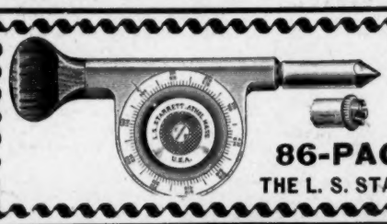

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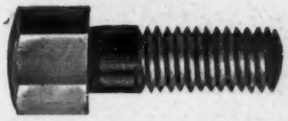

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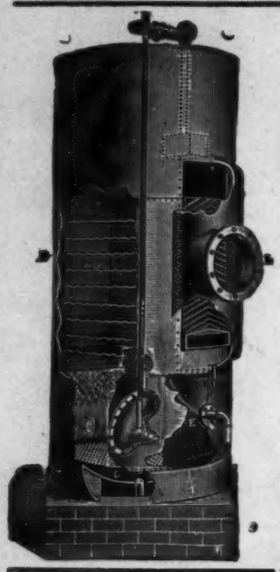

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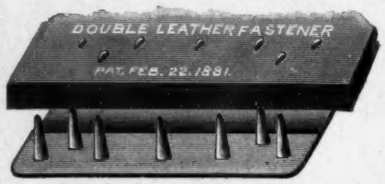

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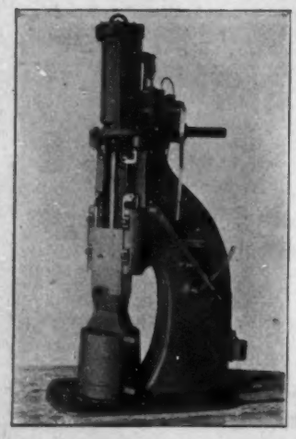

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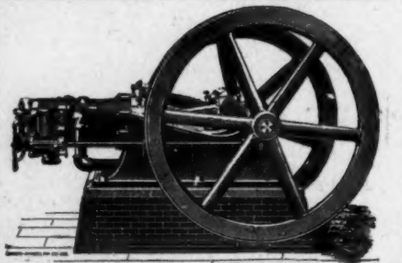

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THE IRON TRADE REVIEW

VOLUME XXVIII. CLEVELAND, O. NOVEMBER 28, 1895. CHICAGO, ILL. NUMBER 48.

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

The week has brought little change in current buying of iron and steel, and has furnished little new light on what may be expected as to prices or demand when the new year opens. It is generally agreed that the next five weeks will be given up to quiet and to maneuvering for position. Producers of pig iron as a rule continue to regard the present situation as containing several parts of artificial or induced weakness to one part that is legitimate and due to an attempt of the market to adjust itself to a new relation between production and consumption. It is not expected, however, that the statistics of Dec. 1 will show a reduction of stocks in November, since consumption has been curtailed in several directions. Another element is the fact that shipments from furnace yard do not indicate consumption in all cases, and on some contracts later deliveries are being asked. The lighter demand for finished material has caused some accumulation of iron at mills and steel works. In the case of foundry irons, however, it would appear that deliveries are being made fully up to contract stipulations and that the iron is being melted as fast as shipped. Current sales of Bessemer iron for prompt delivery are $12.25 in the valley, and this price has been accepted in one or two cases by furnaces whose output will be somewhat larger for the balance of the year than was counted on. A sale of 5,000 tons of Bessemer for delivery in the first quarter of 1896 is reported at $13, valley furnace, and a sale of 10,000 tons at a price somewhat better. It is known that a leading steel company will be a buyer of Bessemer metal for the first quarter, and the natural effect of such purchase on prices strengthens the position of producers. The coke price after Jan. 1 is still a matter of uncertainty. While the nominal figure for furnace coke may be $2, the real basis for contracts may not be more than $1.65 to $1.75, after the manner of the $1.25 and $1.35 contracts now running, under a $1.60 regular quotation. The situation in finished material is summed up in extreme quietness and generally unchanged prices. Mills are taking small orders at cut prices on certain descriptions of material, while on bars and most forms of structural steel producers seem to have taken the position that lower figures will not stimulate demand in the present mood of buyers. Calculations for the early portion of next year generally incline to an outlook for liberal buying. The check on building always seen at this season of the year, is the most important curtailment of consumption. The lack of mill orders may be attributed in large part to the disposition to let stocks of manufactured material in jobbers' and other dealers' hands run down to the lowest point. It is certain that much agricultural buying will come early in the year. The improvement in railroad earnings, that has now begun to show a slight gain over corresponding months in 1892 contains good promise of buying from that direction. Bridge works find indications that 1896 will bring the largest business in years.

THE CLEVELAND DISTRICT.

From Lake Superior ports the last cargoes have gone out and all that remains of the year's shipment by water is to come from Escanaba. Word was sent to Cleveland from that port on Monday that the 35 or 40 boats then waiting for ore were all that could be loaded and that no further boats need be sent. The figures now available show that Escanaba will resume the lead which it surrendered to Ashland for the single year 1894, and that its total will be above 2,500,000 tons. Ashland comes second, Two Harbors third, and Duluth fourth. Preparations are making for an active winter's operations on all ranges, and good stockpiles will be accumulated by spring. Less stockpile ore is left at the mines with the close of navigation than in years. The amount is not sufficient to be any factor in the situation. It will probably be found, too, that stocks at Lake Erie ports are unusually small for Dec. 1, owing to the policy of furnaces to take direct every ton of ore for which room could be made.

Pig Iron. The attitude of furnacemen as to the price of Bessemer iron for the first quarter of 1896 has not been fully developed, though one sale of 5,000 tons for such delivery is reported at $13 in the valley, which is said to be below the basis of the 10,000-ton transaction referred to last week. The position is taken by furnacemen that influences apart from supply and demand have had too much to do in determining the market of late and there are intimations that these forces will not be allowed indefinitely to dominate important vested interests. Where the market will land when producers and consumers generally are ready to do business for the first part of 1896 is still uncertain. Some small lots of Bessemer have been sold in the week at $12.25 in the valley. In foundry irons very little has been done. Current quotations are $14 and $14.50 for No. 2 and No. 1 respectively, though these are shaded by some sellers. A sale of No. 3 is reported at $13.65, a 500-ton sale of gray forge at $12 at valley furnace, and a sale of No. 1 foundry at $14. In Lake Superior charcoal little is doing the bulk of winter requirements having been covered in metal already brought down by water. Prices range from $15.25 to $16.

Finished Material. The week has been practically without development. Cutting on angles by a valley mill seems not to have been participated in by Pittsburg sellers, who are maintaining 1.50c at mill as minimum. Little is doing in bars, but agricultural contracts promise good business in the early part of the new year. Bridge works also have a good run of work in sight. Current structural demand is small, with 1.60c to 1.65c, Pittsburg, generally maintained on beams and channels. Further shipyard work is to be placed.

THE CHICAGO OUTLOOK.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

In some branches of the iron market a considerably better feeling is noticed, evidenced by increased inquiry and larger buying. Other branches of the market, however, are a little inclined to be dull. As a general thing buyers are not willing to load up with contracts for long delivery, preferring to wait a little longer in the expectation of lower prices. In a few lines some weakness is discernible, but most mill and furnace men are entirely willing to make small sales for the time, confident that consumers will be willing to buy at the present and even higher prices in the near future. Car works are still taking large quantities of material of all kinds, although they are not buying in quite as large lots as was the case a week ago. A better inquiry and larger sales are noted of Southern pig iron and Lake Superior charcoal iron, but local coke iron shows little change. Plates and sheets are in better demand, and quite large sales have been made by the local mills, at slightly lower prices.

PIG IRON.—Southern furnaces report sales of two 1,000-ton lots of iron, and a number of small orders, bringing the aggregate up to a larger figure for the week than for several weeks past. The demand is considerably better, and inquiries were in hand the first of this week for over 3,500 tons of Southern iron. Local irons are in light demand, and the furnaces are not, as yet, pushing for business. Some inquiry has been received for delivery next year, but no sales of any size have been made. Lake Superior charcoal iron is selling easier, and several orders of car loads to 50 and 100 tons have been received. Quotations are firm, and are made as follows:

Lake Sup. Charcoal	$15 50@16 00	Southern No. 2 Soft	$ @13 85
Local Coke Fdy. No. 1	15 00@15 50	South'n Silveries No. 1	@15 35
Local Coke Fdy. No. 2	14 50@15 00	South'n Silveries No. 2	@14 85
Local Coke Fdy. No. 3	14 00@14 50	Jackson Co. Silveries	15 50@16 00
Local Scotch Fdy. No. 1	15 00@15 50	Ohio Silveries No. 1	15 00@15 50
Local Scotch Fdy. No. 2	14 50@15 00	Ohio Silveries No. 2	14 50@15 00
Local Scotch Fdy. No. 3	14 00@14 50	Ohio Strong Softeners	15 00@15 50
South'n Coke No. 2	@13 85	Alabama Car Wheel	17 00@17 50
South'n Coke No. 3	@13 60	Malleable Bessemer	
Southern No. 1 Soft	@14 10	Coke Bessemer	

BARS.—Car works are still taking considerable quantities of iron, but no particularly large lots were placed last week. The inquiry from car builders keeps up, and other orders will be given out this week. General business is rather lighter, but will probably be better after the first of the year. Prices are unchanged, as follows: Common iron, 1.50c; guaranteed, 1.60c; soft steel bars from strictly billet stock, 1.60c.

RAILS AND TRACK SUPPLIES.—Business has been light, and the local mills have not booked any very large orders. Quotations are as follows: Rails, $29 and up; splice bars, 1.65c to 1.75c; track bolts, 2.25c to 2.45c; spikes, 1.95c to 2c.

BILLETS AND RODS.—The local steel company took a few small orders for billets last week at $23. No sales of rods are reported, and they are nominally quoted at $29

STRUCTURAL MATERIAL.—The demand is light, owing principally to the weather, which has been unfavorable for building operations. Quotations are made: Beams and channels, 1.90c to 2c; angles, 1.80c to 1.85c; plates, 1.75c to 1.85c; tees 1.90c to 2c. Small lots from stock are quoted ¼ to ½c higher.

PLATES.—A rather better inquiry has been received, and a fair tonnage was booked by the local mills. Prices are made as follows: Tank steel, 1.75c to 1.85c; flange steel, 1.95c to 2.05c; firebox steel, 2.85c to 5c; boiler tubes, 60 to 65 per cent discount.

MERCHANT STEEL.—The situation is about as last reported, and quotations are unchanged, as follows: Open-hearth spring, tire and machinery steel, 2.20c to 2.25c; smooth finished machinery steel, 1.95c to 2c; smooth finished tire, 1.90c to 1.95c; tool steel, 5.50c to 7.50c; specials, 11c and upwards; Bessemer bars, 1.65c to 1.75c.

SHEETS.—Inquiry is considerable larger, and it seems probable that the sales of the present week will be quite large. The local mill reported inquiries for over 1,300 tons of black and galvanized sheets received on Monday alone. Quotations are off a little, being made now at 2.65c to 2.70c for No. 27 common iron by Western mills. Eastern mills are quoting 2.70c to 2.75c. Galvanized iron is also a little easier at 75 and 5 to 75 per cent discount.

OLD RAILS AND WHEELS.—Business has been very light, and will probably remain so until the first of the year. Old iron rails are quoted at $16.50 to $17; old steel rails at $12.50 to $13.50 according to length, etc., old wheels $13 to $13.25.

SCRAP.—Demand is very small, and sales are few and far between. Probably no very large business will be done before Jan. 1. The following are buying quotations furnished by dealers: Railroad forge, $13; dealer's forge, $11.50; No. 1 mill, $8 to $8.50; railroad cast, $10; machinery cast, $11; axles, $16; cast borings, $6; wrought turnings, $7.50; axle turnings, $8.50; mixed steel, $10; stoveplates, $6 to $6.50; heavy melting steel, $12.50.

IN OTHER MARKETS.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

Pittsburg. A dull market, with weakening prices in cruder products and very few orders for finished material, is the general report among the local trade for the past week. Some of the mills are asking for a postponement of deliveries of iron because metal is accumulating with them, owing to curtailed shipments of their products. In some departments of the market finished material is quieter than at any time since the early part of the year. Bessemer pig has sold at $12 to $12.25 in the valley. A Pittsburg sale of 3,000 tons is reported at $12.75. Some furnaces appear to have more metal to sell for prompt delivery than had been allotted on. In the price of gray forge, the falling off has not been proportioned to that of Bessemer, owing to the absence of any speculative element. A 500-ton sale was made this week at $12.25, Pittsburg and smaller sales are noted at $12.50. No. 1 foundry has sold at $14 to $14.50 and No. 2 at $13.75, and there has been little market. Steel billets continue to drag, In the Wheeling district, the price has dropped to $18.25 and $18.50. Sales of 1,000 tons at $18.50 and of 2,000 tons at $18.40 Wheeling, have been reported. A Pittsburg transaction involving 1,000 tons was at $18.75. Prospects for muck bar are not encouraging with the dull market prevailing for wrought pipe. While structural demand at the moment is light, prices are maintained on the 1.60c basis for beams and channels. There is promise of good demand in the early portion of the new year. Old material is dull and dealers are not trying to push sales. In old iron rails a sale of 500 tons is reported at $17.50 valley mill. Old steel rails have sold at $14.50, and a transaction in heavy melting steel is reported at $14.50. There has been an unprecedented shipment of Connellsville coke recently and the furnace companies appear to be taking liberal stocks in anticipation of the advance of Jan. 1. In the week ending Nov. 16, the production is estimated at 164,280 tons, a falling off of 10,380 tons from that of the preceding week. Shipments, however, were the greatest on record, being 10,181 cars. About 25,000 tons of stock coke was shipped off the yards.

Cincinnati. The time is rapidly approaching when many large contracts for pig iron will expire. Most consumers are arranging to carry very light stocks during their period of inventory and their invitation to salesmen is to call again about Jan. 1. Requests to withhold shipments are infrequent. The close of 1895 will witness the smallest stocks of pig iron in hands of both producers and users that have been seen for years. Much interest is evinced in the outcome of the waiting game now being played. Speculators and holders of lots purchased at lower prices are seeking buyers in every direction and recently inquirers have had quotations showing a difference of $2 a ton between those made by furnace agents and holders of speculative lots. Such wide variations will not exist when demand improves. So far as can be ascertained, stocks at furnaces are decreasing, but it would not be surprising if no material change is shown Dec. 1. The largest Southern producer is supplied with orders for four months' output, and can afford to wait before pressing for sales, until consumers decide to buy. The general expression is that all classes who melt pig iron prefer to see a high range of values during next year and they will cheerfully place contracts for round lots at whatever the price may be, just as soon as it is demonstrated that there is business enough to absorb the increased production.

PRESENT MARKET FOR MACHINERY.

Although, as compared with a year ago, business in the standard lines of machine tools shows marked improvement, it has dragged rather heavily through the summer, and is now moving but slowly toward a better situation. Still, its tendency is in the right direction, and a more buoyant feeling exists than hitherto. Prices have not kept pace with the cost of labor and raw materials, but there has been some advancement. After the quiet summer, they are as high or higher than last spring, and rule steady, with a slight inclination to rise.

Demand has been lively for tools for bicycle manufacture, especially screw machines, the supply being, in some cases, several months behindhand. It is reported, however, that within the last two weeks this branch of trade has become a little less brisk, while the call for general machine tools has been increasing. The lighter lathes used for locomotive work are in fairly good requisition. Second-hand machines find a ready market. The movement of trade in small machine shop supplies, such as files, has been very different from that in power machinery. After a spasm of activity which took place a few weeks since, there has been a gradual quieting down of business. Woodworking machinery is stagnated in New York and vicinity, but conditions are more favorable in Boston and in the West. It is found more economical to manufacture sashes, doors, etc., in large quantities in the West and ship them to New York, than to transport the rough lumber and work it up here.

In power transmitting machinery there is a fair business doing, but prices are stationary at a low level. When raw materials were selling at low rates, manufacturers stocked up, and having now about exhausted their supplies, must soon purchase more, and advance their prices. As regards leather belting, this rose 20 per cent, when, earlier in the year, hides went up 50 per cent. The latter have fallen back 10 per cent, but belting has held its own, and with leather becoming scarcer, dealers do not fear a decline. A seller of railway contractors' supplies reports a quiet domestic, but fair export trade, with prices tending toward rock bottom.

The engine trade shows a moderate demand. Export features are among the most hopeful, though the Spanish-American market is for the present about closed. At home there is a call for engines for large office buildings and manufacturing establishments; but this being a season when factories should have the essential parts of their equipment ready for actual work, it is not to be expected that such installations will at present become more frequent. Competition is so sharp that prices are keep down, another depressing influence being the tendency of buyers to choose cheap articles, even though somewhat inferior. For large high-speed electric light engines, the demand is now slackening, November being naturally a quiet month. Corliss engines are reported to be in steady selling.—[American Machinist.

CHEAPER SHEETS REPLACING PLANISHED.

In a paper read before the New York Railroad Club recently, E. E. R. Tratman discussed as follows the substitution of painted for planished iron jackets on locomotives:

"The use of planished iron has been almost universal in this country, until within the past few years some roads have been making experimental trials of common sheet iron painted. It has very frequently been assumed that the painted jackets would be the more economical, and European practice is commonly cited as an example of this kind of work. The results of my inquiries on the subject point to the conclusion that if painted jackets are adopted with a view to economy they may be made far more economical than the planished jackets, but the mere substitution of the former for the latter will not necessarily insure economy, as the work of painting may be so elaborate as to make the finished jacket very expensive. In this respect European practice (and especially English practice) is by no means to be recommended, as the variety of colors used, the varnishing and finish, the amount of striping and decoration, and the time consumed are all opposed to any ideas of economy, as noted further on.

"A planished iron jacket is necessarily expensive in first cost, it requires considerable care and cleaning on the part of the fireman, the thin metal used soon gets dented and battered, the drippings from the roundhouse roof will eat away the enamel, and when the surface begins to rust or to wear in bright spots the jacket soon looks shabby and must be renewed. A much cheaper quality of iron is used for a painted jacket, and if economy is the first consideration the painting may be cheaply done and yet be of fairly good appearance, durable and costing little for maintenance. Since the common iron or steel is as efficient as the more expensive planished iron as far as clothing purposes are concerned, the use of the former would seem to be based on true principles of economy. You start in with the cheaper, but equally good material as a foundation, and on this you can expend as much paint and labor as is consistent with the financial condition of the road and the standard of appearance thus desired. Such a jacket should last as long as the boiler, so that there is no expense for renewal, and the expense for maintenance is limited to occasional painting, which may be more or less frequent according to the circumstances of individual roads."

The writer gives at some length the practice of the various roads in regard to planished iron and finds that there is s very general substitution of the plan painted sheets. The economies of this practice are figured by G. W. Rhodes, superintendent of motive power of the C., B. & Q. Road, as follows:

No. 24 Wood's planished iron jacket:	
310 lbs. of iron at 9 15	$31.11
Tinner's labor for putting on jacket	6.00
Total for planished iron jacket	$37.11
No. 24 cold rolled steel jacket:	
340 lbs. steel at 3 12	$10 61
Tinner's labor for putting on jacket	6.00
2½ pints Roger's engine black at $.65 per gal	.83
Labor, 2½ hours at 20 cents per hour	.50
Total for painted steel jacket	$17.94

In making deductions from the data furnished him, Mr. Tratman says, that the use of the painted jacket is ordinarily in the line of economy, though the decorative painting of the plain jacket may make it cost more than that of planished iron. The maximum economy seems to have been reached by the C., B. & Q. Road, as shown in the figures cited above.

THE changes being made at the Rosena furnace, at New Castle, Pa., will make it one of the best equipped furnaces west of the Allegheny mountains. The engine room has been partly torn down and rebuilt, and the roof is being raised so as to provide more space for the engines.

BUFFALO furnace at Buffalo, which has been out several weeks for relining, will blow in about Dec. 1.

THE IRON TRADE REVIEW

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"NATURAL advantages" for economical steel-making have much to do with the cost of product at the plant of the producer. How much of an element the advantage of low assembling costs shall turn out to be in the price of the product delivered at important consuming points is something about which railroads have had a good deal to say, perhaps a good deal too much. Secret rates, rebates and concessions to particular districts and particular manufacturers have done much to neutralize advantages of locality. And thus it has come about that low costs that could be figured out on paper with the precision of mathematics, have not been allowed to help one district or hinder another. Traffic built up in one district must not be allowed to slip away, railroads argued, and large expenditures for terminal facilities must yield their usual return, geography or changed conditions to the contrary notwithstanding. When due consideration is given to this fact, much of the odium that usually attaches to railroad pooling arrangements is removed, and they are recognized as in a sense a corrector of injustice and inequality. The railroad pool recently organized is calculated to put an end to rebates and special concessions and give to each manufacturing center its legitimate advantages of proximity to sources of raw material and to consuming districts. Much of the trouble in adjusting wages in various coal mining districts has been due to the freights established by the railroads, based, not on the length of the haul, but on the decision of a railroad to limit production in one district and to artificially stimulate it in another. Instances can be cited in connection with iron and steel manufacture, in which like action by carriers has put up one point and pulled down another. The rigid enforcement of established rates, under the heavy penalties of a strong organization, is one step toward the restoration of a natural equilibrium.

AN English exchange comments on the falling off in exports of agricultural implements from Great Britain and says that manufacturers of such machinery in the United States have been taking British trade in South American countries. The fact appears to be that American implements are making headway in markets closer to the British manufacturer. The Argentine Republic took $1,514,194 worth of agricultural implements from the United States in the year ending June 30, 1894, and $1,004,551 worth, or only two-thirds as much, in the fiscal year 1895. The financial disturbances in Argentine were the cause of the shrinkage in exported machinery both from Great Britain and the United States. But the significant fact about the agricultural machinery exported from the United States is that the gains in the fiscal year 1895 over the preceding year were in shipments to the United Kingdom, Germany, France and "Other Europe." To these countries the total export of such machinery from the United States was $2,059,663 in the fiscal year 1894 and $3,071,469, or 50 per cent greater, in the fiscal year 1895. The increase is due, not to an inroad on the British implement trade in neutral territory, but on the British manufacturer's own ground, and may be fairly attributed to the rapid improvement in American agricultural machinery in the past few years.

WESTERN manufacturers of steel castings practically decided at a meeting held in Chicago, last week, to follow the example of the steel casting companies in the East in establishing a 4-cent base price for their product. The steel casting interest has been quite in the rear of the movement for better prices that has given birth to organizations in various branches of the iron and steel trade in the past six months. Eastern firms have been urgent for a higher basis, but when any particularly attractive contract was to be let, there were evidences that performance was not up to the standard of preaching. Indications now are that the Western concerns will be able to come to such an understanding at Pittsburg next week as will limit the incursions into distant territory that have been complained of heretofore, and for a time at least ensure a fairer return to the maker.

THE smaller imports of tin plate to the United States continue to be a feature of the trade and there is already some uneasiness on the other side over the prospect that American tin plate works may profit by the conditions that have arisen, due in part to the increased cost of raw material to the Welsh manufacturer. A Swansea market report of Nov. 15, has the following regarding the tin plate market there:

> The shipments are small, possibly in consequence of the stress of weather preventing the arrival of tonnage. There is very little business doing, as manufacturers do not see their way to sell forward in the face of the advancing value of the raw material, and will only carry on their works while the existing contracts last, and these will be nearly completed by the end of next month. The offers made by buyers, it is stated, are still receding; while, on the other hand, the cost of manufacture still continues to be on the increase, so that there can be but one inevitable result, and that is the works will have to stop rather than make at a serious loss.

THE effort of manufacturers of structural steel to standardize sections of shapes and to reduce the departures from such standards is making good headway. The expectation is that the outcome will be as successful as was the movement among steel manufacturers a few months ago for an amendment of specifications.

NOT only would a high price for Connellsville coke invite larger competition from the well known West Virginia fields, but the day of extensive building of retort ovens, in which a considerable percentage of non-Connellsville coals can be used, would be hastened.

LAKE SUPERIOR IRON MINES.

The new crusher which is to be installed at the Champion mine, has several features in which it differs from those previously in use at hard ore mines on Lake Superior, and which we are enabled to speak of in detail. The pitman is of steel, instead of iron, as heretofore, and weighs 7,600 pounds. An oil well is provided, in which the eccentric shaft is allowed to come into direct contact with the oil, practically running in it. This overcomes the excessive friction. Another novelty is the hole left in the body of the pitman, large enough to permit a man to reach through, and admitting of examination of the front toggles. This overcomes the difficulty experienced in all the larger machines of this class, on account of the jaw and pitman being so close together as to make it impossible to get in between them. The hole also serves the other purpose of relieving the pitman of some of its weight. This was possible in using steel instead of iron. The Champion Iron Co. is now putting up a new permanent crushing plant, consisting of three crushers, set side by side directly over the railroad track. These will be run by manilla rope transmission from corresponding pulleys 10 feet in diameter on the crushers and engine shaft, and driven by a pair of Corliss engines. The plant is centrally located 300 feet from the boilers which furnish the steam for the whole mining plant. The ore from the different shafts will be run by gravity direct from the skips to the crushers and from them will be conveyed to the stock-pile floors in winter, but in summer will fall directly into the railroad cars, which in turn are moved by gravity. The whole arrangement is made with a view to economizing as much as possible the cost of reducing the ores of this mine to a size found to be most desirable to furnacemen. Thus reduced, this ore is found to make a desirable mixture with the finer ores of other ranges. The crushers were made by S. E. Cleaves & Son, Hancock, and Lake Shore Iron Works, Marquette, Mich., with the exception of the pitman which was made by the Detroit Steel & Spring Co., Detroit. The steel eccentric shafts were furnished by the Cleveland City Forge & Iron Co. The new crusher weighs 55 tons. The opening is 24″ x 24″. Sectional area of each side, 660 inches.

The shipment of ore from Vermilion and Mesabi range mines to Two Harbors docks was completed last week, but as several cargoes have not yet left the docks the exact amount shippied down the lakes cannot be determined as yet. The *Iron News*, of Two Harbors, gives the shipments to dock from the various mines as follows: Minnesota, 431,589 tons; Chandler, 600,990; Pioneer, 40,053; Auburn, 374,208; Canton, 359,020; Norman, 93,391; Fayal, 136,601; Hale, 29,896; Vega, 47,701; Cincinnati, 17,186—making a total of 2,130,635 tons against 1,382,144 tons in 1894, the largest previous year.

Shipments of ore from Ashland closed for the season Nov. 25, the total to that date being 2,350,225 tons, of which the Northwestern shipped 1,201,978 tons and the Wisconsin Central 1,148,247 tons. The bay is frozen with ice and tugs were kept busy freeing the boats taking out the last cargoes.

A new body of ore said to be similar to that of the Fayal and Adams has been explored near Eveleth. Testpitting and diamond drill work have shown a large amount of ore and of excellent quality. The property was discovered under the superintendency of D. T. Adams, of Duluth, and is owned by E. M. Fowler, Simon J. Murphy, Temple C. Doerr, George O. Robinson and E. Flynn, all of Detroit, Mich. They also own the fee of the Vega, Adams and Fayal and are also interested in the Eveleth townsite.

The Dessau Mining Co., successor to the Millie Mining Co., has filed articles of incorporation in Michigan. The capital stock is $25,000, and the directors are Simon Dessau, S. A. Dessau, John R. Rogers and Charles McGregor.

October a Good Month for Railroads.

The latest issue of the *Chronicle* contains the customary compilation of railway gross earnings, this time for the month of October. The results for the month are the best that have been recorded since the revival began. The statement includes 139 railroads, working 104,000 miles, and on these the gain in gross earnings over October of 1894 was 6.59 per cent. Of all these roads only 37 show decreases. There are 11 railroads included in the list which show gains in gross of over $100,000 each, and this list is headed by the Chicago, Milwaukee & St. Paul with a gain of $861,000. The Great Northern comes next with $372,000 and the New York Central is next with $349,000. The Northern Pacific has gained $314,000. The Burlington, Cedar Rapids & Northern and the Illinois Central each gained over $200,000. The Burlington figures are not yet published, but it is presumable that that system will show large gains. The list of roads which lost is headed by the Texas & Pacific with $227,000 lost. The Missouri, Kansas & Texas follows with over $175,000, and the other roads showing losses are the International and Great Northern, the Atchison, the St. Louis Southwestern and the Buffalo, Rochester & Pittsburg. Generally speaking, the gains are attributable in a very great degree to the large movement of grain, which at the Western primary markets for the five weeks in 1895 was 85 per cent more than the movement in 1894; that is, it amounted to 83⅓ million bushels against 45 millions. Chicago was the greatest gainer of any single point in this large movement. The losses, which with few exceptions are in the Southwest, are attributed to a short cotton crop and its slow movement to market. Moreover, the present comparison is made with a month in which the Southwestern roads made, in many instances, the largest October earnings on record.—[Railroad Gazette.

Good Work of the Foundrymen's Associations.

J. S. Jeans, secretary of the British Iron Trade Association, whose visit to the United States last year will be remembered, is now reporting in the Bulletin of that association the results of his inquiries into the costs of iron and steel making in this country. In his last instalment, Mr. Jeans gives figures as to the wages paid in the various departments of foundry work in this country. These were obtained from the proprietors of well known establishments in Philadelphia. Commentiug on the improvement in foundry practice made in recent years in the United States, Mr. Jeans makes the following appreciative reference to the work of the Western Foundrymen's Association: "Everyone who has any knowledge of the American iron industry is aware of the remarkable advance that foundry practice has made of recent years. One of the most effective instruments in this direction has been the work of the several associations that have been constituted in different parts of the United States for the purpose of advancing the knowledge of foundry work in its various aspects and departments. The Western Foundrymen's Association especially has rendered very useful service, and has pointed out many directions in which economy in foundry work is possible."

CAR and locomotive building: The Nickel Plate has placed orders for 1,000 cars recently, the bulk of them going to the Michigan Peninsula Car Co. The C. & O. has ordered 100 gondola coal cars from the Ensign Mfg. Co. The South Baltimore Car Works are building 50 coal cars to be used on the B. & O. The receiver of the Toledo, St. Louis & Kansas City asked a court order to buy 500 coal cars. Norfolk & Western has placed with the Ensign Mfg. Co. an order for 500 box cars. The Ohio River Road has ordered two freight locomotives from the Brooks Locomotive Works. The P., Ft. W. & C. Road has just completed the seventh heavy freight engine for this year at its Ft. Wayne shops.

THE detailed record has been issued, of tests made by the P. H. Griffin Machine Works, at Buffalo, Nov. 8 on car wheels made by the New York Car Wheel Works, also of Buffalo. The requirements and the results were given in these columns one week ago. The tests, which were those required for cast steel wheels and for steel tires on the most important European railways, demonstrated the results attained by the New York Car Wheel Works in making chilled iron wheels from special mixtures. In all cases the wheels tested not only stood the requirements imposed but considerably exceeded them.

YOUNGSTOWN, O., has prospect of a tin plate plant. It is reported that the building of the old malleable iron works will be occupied. Most of the capital is to come from outside of Youngstown.

STOCKS in American Pig Iron Storage Warrant yards Nov. 20 were 109,400 tons.

THE WESTERN FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Western Foundrymen's Association was held Wednesday evening, Nov. 20, at the Great Northern Hotel, Chicago. The President, John M. Sweeney, occupied the chair. Those present were the following: Thos. D. West, Thos. D. West Foundry Co., Sharpsville, Pa.; A. W. McArthur, Rockford Foundry Co., Rockford, Ill.; J. T. Rowlands, J. I. Case Threshing Machine Co., Racine, Wis.; G. H. Carver, Plano Mfg. Co., West Pullman, Ill.; E. H. Walker, Emerson Mfg. Co., Rockford, Ill.; John Pettigrew, Illinois Steel Co., Joliet, Ill.; John M. Sweeney, A. L. Bowen, Chicago Consolidated Iron & Steel Co, Harvey, Ill.; Wm. M. Wilson, Cleveland Facing Mills, Cleveland, O.; James Frake, W. F. Harrower, Jas. Frake, John Fraser, M. E.; A. J. Oehring, J. Barr, Western Electric Co.; D. De La Fontaine, Crane Co.; O. T. Stantial, H. E. Bullock, L. W. Lukens, Illinois Malleable Iron Co.; H. L. Hotchkiss, Deering Harvester Co.; M. C. Bullock, M. C. Bullock Mfg. Co.; Prof. J. D. Young, Armour Institute; C. E. Louis, Forster, Hawes & Co.; A. M. Thompson, Link-Belt Machinery Co.; E. E. Hanna, Wm. Ferguson, Gates Iron Works; H. F. Frohman, Jas. E. Evans, S. Obermayer Co.; W. D. Barton, Siemens & Halske Electric Co.; A. Sorge, Jr., M. E.; S. T. Johnston, Whiting Foundry Equipment Co.; P. L. Sutter, L. Wolff Mfg. Co.; James Brady, G. C. Batten, Kurtz & Buhrer Foundry Co.; Ed. Welch, Wier & Craig Mfg. Co.; Leo. Salomon, Will Salomon, Chicago Architectural Iron Works; R. F. Palmer, *Industrial World*, and B. M. Gardner, *The Iron Trade Review*, all of Chicago.

Mr. Sorge reported that the committee on headquarters for the association is in a position to report progress and to ask for more time.

Mr. Frake reported that the committee on by-laws had prepared a complete set of by-laws, but as there were several papers to be read, he moved that the by-laws be printed and distributed to each member of the association, and the consideration of them be postponed until the next meeting of the association. The motion being duly seconded, was carried.

The secretary read the following applications for membership, which, on motion, the nominees were unanimously elected: G. H. Carver, Supt. Plano Mfg. Co., Chicago; Rogers, Brown & Co., Chicago; Bates Machine Co., Joliet, Ill.; Buffalo Forge Co., Buffalo, N. Y.; Chicago Architectural Iron Works, Chicago; William Berquist, Ornamental Iron Co., Chicago.

Mr. Thomas D. West, of Sharpsville, Pa., read a paper on "Stretching Cast Iron and Elements Involved in its Contraction." It will be found in another column.

The secretary read a paper by Mr. W. J. Keep, of Detroit, on "Properties of Cast Iron shown by Keep's Cooling Curves." It is given on another page.

DISCUSSION.

Mr. West: I would like to ask the privilege of opening the discussion with a reply to Mr. Keep's paper. Mr. Keep says: "Knowing the silicon in any iron mixture and size of the casting the shrinkage can be computed by Keep's graphic shrinkage chart." I disagree with Mr. Keep and say no chart can be devised to achieve such a result. I can take, and so can any practical founder, most any casting that is made and having all conditions exactly alike, as far as it is practical in the molding and making of the casting, have a great variation exist in the contraction of two castings, simply by knowing the percentage of sulphur in the iron, owing to the fact that one part of sulphur will neutralize from 10 to 16 parts of silicon, so effective is sulphur in affecting a change in the grade of an iron. It is wolly impractical to substantiate the claim which Mr. Keep has made as regards his chart truly defining the character of a casting when only the silicon contents and the size are known. Further on Mr. Keep says: "A slight variation in the sulphur and manganese will not exert any perceptible influence upon the amount of graphite or upon the size of the grain." This is a most vague expression, owing to his not defining what he means by "slight variation." I know from experirnce that a slight variation of .02 in the increase or decrease of sulphur where the silicon remains constant, can affect the contraction and degree of hardness of an iron. I also know from experience that in re-melting iron, there is always considerable variation in the amount to which sulphur is increased in any two heats. In my practice, I am as careful of the sulphur contents, if not often more so, than of the silicon. I do not wish to be understood as affirming that a device cannot be arranged to determine the true contraction of an iron. To make this practical, only requires us to ignore attempts at defining the percentage of the separate metalloids which may control contraction and simply refer to them as a whole, to be covered by the word "grade," as will be noticed is done by the writer in his paper. At the end of Mr. Keep's paper, after he has labored to prove the infallibility of set rules, charts, etc., to define the contraction of castings, he then destroys his argument by publishing comments from Mr. David Matlock, which speak louder than anything which I have said to prove the incorrectness of trying to tell the contraction of a casting solely from a knowledge of its silicon contents. With regard to the assertion that Mr. Keep's machine "is practically frictionless," this tells us nothing. It is impossible that those levers could be moved without some power, and I am as interested as any one in knowing just what that power is; for contraction can be affected by the smallest amount of restraint. If those erratic lines are recorded with the fullest freedom allowed for contraction, in Mr. Keep's device, then the impulsive erratic movement of my restrained bar recorder is due to something other than contraction. Not until I have personal knowledge of all the details in the construction, and the exact power required to move the levers in Mr. Keep's device, can I be convinced that his so called expansion curve, after molten iron has solidified, is due to anything other than retarding free contraction of stretching iron. My restrained bars show about the same kind of wild erratic curves as those recorded by his device, the main difference being, as will be noticed by contrasting the action of the two methods, most of the expansion and contraction takes place sooner by my method than by Mr. Keep's. I would attribute this to the conditions causing my bars to cool quicker by being cast in "open sand," whereas Mr. Keep's were cast with a cope on them. There is one point I am a little curious about, and that is, I believe that Mr. Keep's device should show a greater expansion than it does, and would do so, were it not restricted in some manner. In closing, I have a question to ask. Why is it that both our devices clearly define that an expansion takes place at the moment of solidification, and if such takes place afterwards, why does not my free bar record it the same as it does when the iron is under strain?

Mr. Sorge: In discussing this paper, I will first state a few premises before going into a detailed consideration, which is difficult on account of the absence of exact data: The mixture of iron used in a casting determines the shrinkage, all other things being equal. In other words, if the characteristics of the casting to be produced are known and its principal dimensions, then we can decide on the mixture of iron to be employed, and this mixture will have a definite shrinkage for each thickness, if extraordinary conditions do not prevail. By extraordinary conditions, I mean either very rapid or very slow cpoling, great differences in thicknesses of various parts of the same casting, ill-constructed molds or radical changes in manipulation or pouring. If the molds and cores are properly made, and their construction has been taken into account by the pattern-maker, then the size of the finished casting can be predicted very closely by the foundryman who carefully studies the characteristics of the mixtures of iron which he employs. Iron always shrinks when cooling from the liquid state down to ordinary atmospheric temperature. If a casting turns out larger than the pattern, or even of the same size, then there has been faulty work done in the foundry by the molder or core-maker, or in the pattern shop by the pattern-maker. In all considerations of this kind, it must be assumed that the different parts of the casting have been properly proportioned. If this is not the case (and unfortunately the proportions are frequently bad) then special provisions must be made to partially neutralize the effect of the bad proportions, or better still, the design should be changed.

Mr. West states that the secret of thin castings contracting more than thick ones lies entirely in the formation of smaller molecules and grain in the former than in the latter. I presume he means by this that the smaller crystals in the thinner

castings will arrange themselves more compactly than the larger ones in the heavier castings, and thus take up less room, thereby making the castings smaller and shrinkage greater. I do not, however, think his comparison to the "raising of bread" a very apt one, as the increase in bulk of the dough is due to fermentation, and not to any crystallization. If the fermentation is carried on for a prolonged period, the dough will shrink again, owing to the expulsion of the gases which formed during fermentation.

Mr. West claims that the period of cooling has more to do with the shrinkage than the chemical composition. But he must admit that under equal conditions of cooling the varying composition of the iron will determine the shrinkage. In the ordinary foundry it is customary to so proportion the mold and to so time the period of shaking out and the amount of covering, that this time of cooling shall be fairly uniform for different pieces of similar size, and it is only in exceptional cases, as it were, that special pains are taken to either hasten or prolong the cooling period. Therefore, although all experienced foundrymen are well aware of the effects of varying cooling periods, this condition is usually assumed to be uniform in a given foundry and we are led to look to the chemical composition of our iron as the controlling element in the shrinkage and not to the cooling period.

Mr. West makes the assertion that the test-bars in the recording apparatus originated by Mr. Keep are strained and not permitted to contract freely. I have myself seen the apparatus, and have witnessed a record made by it, and can bear testimony to the fact that the bars are free to expand or contract, except in so far as the sand of the mold would offer resistance. The apparatus itself cannot put a strain of even as much as a few pounds on the bar, as the only resistance is due to the moving of the levers carrying the drum driven by clockwork and the recording pencil. I have a letter from Mr. Keep which somewhat supplements his article, and I will read an extract therefrom on this subject:

"This is a sketch of my new machine, which is exactly the dimensions of the first one. The shaded arm with slide belongs to the pencil. The other belongs to the revolving drum. These move in opposite directions, and as each arm multiplies 10 times, the record multiplies 20 times. The front of the flask is cut away to allow the frame of the machine to be hung on. The test bar lies in an ordinary mold free to move in the sand in every direction (without any yokes). The machine is as near frictionless as it is possible to make it. The sand is scraped away at each end to expose the surface of the mold which is covered with pieces of tin through which steel pins enter the mold. These sheets of tin move between the sand of the cope and nowel quite freely. The record would not be materially influenced if the ends of the bar were fastened to the ends of the flask, as the power exerted by the bar in shrinking is near half a ton and it would pull out the ends of flask. To illustrate: I used large pieces of tin 4″ wide and clamped the edges between cope and nowel of a new flask as tight as I could. The test bar was 1″ wide by ⅛″ thick by 24″ long. The tins were drawn through enough to strongly mark the surfaces.

"Under the gate the bar was drawn open while the metal was plastic but as soon as set, the whole shrank and pulled the tins through from between the wood surfaces. The test bar was not influenced in the least and if it had been run with a gate as thin as ⅛″ it would probably have remained intact. At one time with a 1″ square bar I had fastened the outer ends of each arm and forgot to loosen them. When I returned the frame of the machine was badly strained, but on releasing I found that I had a perfect record. The friction of a sand mold on a straight casting could not influence the shrinkage. If any part pulled off it would have been fluid (plastic), while the rest had begun to shrink. An inch square bar with two per cent silicon does not begin to shrink until it loses its bright red and it would then require at least 700 or 800 lbs. to influence its shrinkage."

Mr. West defines expansion in iron as being an action which only takes place at the moment of solidification. I beg to take direct issue with him on this point. Expansion may and does occur in a number of instances that have no relation to the change of molecular condition which occurs at the moment of solidification. Expansion increases the volume of a body and this increase may be due to various causes, but is generally due to the heating of the body. In wood, expansion is generally caused by the absorption of moisture, in other bodies by the formation of gases, etc. Again he states that "stretching is due to artificial influences exerted by conditions in casting cooling and forms of patterns, to overcome or retard free contraction. It can make castings larger than the patterns from which they were made, and also makes it possible to obtain acceptable castings which could not be secured were it not for the ability of iron to be stretched." The fact is that stretching is the elongation of any body due to tensile strains, whether these strains are due to a resistance to free contraction while the casting is being made or are intentionally applied by external means at any time. It has been well known for a long time that all bodies can be stretched or elongated by putting strains on them, and the amount of this elongation due to a given strain depends upon the condition of the body. It will naturally be greater in a plastic body like iron directly after solidification, than in a cold body.

The apparatus constructed by Mr. West to show the effect of tensile strains on bars of iron does not appear to me to be sufficiently accurate to give results that can be relied upon. We have no means of showing the effect of the hot test bars in close proximity to the iron frame of the same, and the expansion of this iron frame due to conduction of heat did unquestionably affect the records. Furthermore the shrinkage of the iron contained within the clamps themselves would certainly influence the movement of the pointer by leaving the chilled iron in the clamps loose, and would be more pronounced when the bar is under strain than when free. It appears to me, therefore, that the results, although interesting, cannot be used as a basis for accurate conclusions. The construction of the apparatus makes the observation unreliable. The statement by Mr. West that the movement of the pointer to the right of zero indicates expansion at the moment of solidification seems to me unwarranted. If the metal is still fluid its expansion can not be correctly shown by this device, as this expansion would take place in the direction of least resistance, and we have no means of determining that the resistance is smallest in the direction of the length of the bar. Furthermore the gates will act as feeders if there happened to be any contraction while in the fluid state. All extra supply of metal must be cut off from a test bar if it is desired to determine the expansion or contraction of same before it becomes solid. I neither assert nor deny that there is an expansion of the iron at the moment of solidification, but this apparatus will not show it conclusively, and I know of no accurate experiments ta determine this question.

I should like to ask Mr. West how he determined the temperatures from 1,600 to 1,200 degrees F., at which he states iron stretches most easily. Such high temperatures are usually difficult to determine, except with special instruments of great delicacy. With the data presented to us and on account of the construction of the instrument, I do not think that any reliable conclusions can be drawn from the results presented.

I would also like to ask Mr. West whether the thickness of the Martin pump casting he speaks of was not less than intended. It appears to me that if the cores expanded and the mold was strong enough for its work, then the space between them must have become smaller than intended. I would further like to ask how the cores in the cylinder castings made by Wm. Tod & Co. are constructed. Are they built up entirely of ordinary brick, or are series of loam bricks used so as to permit the cores to crush in under the shrinkage strain?

As to the criticism on the technical schools and colleges, I would state that the question which Mr. West thinks of so much importance, is one of a large number that are brought to the attention of the students, but their application to practical work depends upon the individual. Some of these readily grasp the bearing of what they have learned while others forget. These technical schools are yearly improving their courses and fitting their graduates better for practical work.

Mr. Carver: I would like to ask Mr. West if he really meant what he said when he made the remark that he paid more attion to the amount of sulphur than the amount of silicon in the mixture.

Mr. Sweeney: We will give Mr. West a chance to answer all the questions in his closing remarks.

Mr. Ferguson: I would like to ask Mr. West whether he

ever had any data regarding the contraction of a cylinder vertically as compared with its diameter.

Mr. Pettigrew: As regards the shrinkage of cylinders, I have had some experience in that line. Our practice used to be to make them to the shrinkage rule exactly. We would have the core made exactly to a gauge-stick, and invariably, I have seen the cylinder just a little too big. Of course, the question was how did this come about. I think any person in that kind of a fix, if they will take the pains and measure the core of the cylinder after it comes out of the oven will find the expansion of the sand is the cause of it. You will find that there is a great deal about the expansion of material of which the mold is made. I use loam brick for cores. I agree with Mr. West that sulphur has a greater effect upon iron than is generally taken into consideration.

Mr. West: I would like to have had the members express themselves a little more freely on the subject of expansion and the cooling curve question. It is one that has troubled me a great deal, and I am as anxious as Mr. Keep to ascertain the cause of it. Mr. Sorge tells us there is practically no power required to move the levers. He says that the arms may weigh three pounds apiece, which would be six pounds. There is one experiment that I should like to see tried. That is simply to take hold of the short arms of the lever with a pair of steelyards, and believe by that means it will be possible to tell just what power it takes to move the levers. I had an apparatus somewhat like this only the levers were longer and the friction of the rods was pretty tight, so there was no lost motion, but I found in applying the steelyards to the short arms of the lever that it took a great deal of power to move them, and I am inclined to think that if the experiment were tried with Mr. Keep's device he would be surprised at the power required to move his levers. Mr. Sorge has questioned the utility of this device here. I do not think a simpler device could be made. There should be a little play to the lever. I asked the question at the close of my remarks on Mr. Keep's paper, why we should find the expansion recorded precisely the same in the two devices. We see by my free bar that it will expand. Mr. Keep's shows that also. Now if there is an expansion in the iron after it has solidified what is there to prevent the free bar from showing it. I think when you take up that question and try to answer it, you will be led to see there must be something in Mr. Keep's device that requires power.

Now, regarding the question whether a casting can be truly larger than the pattern. Of course, leaving out of the question head pressure and ramming, we will suppose the casting is properly made. I showed in my paper that I had stretched one of those bars a quarter of an inch longer than the other with a weight suspended. We can prove that we can stretch iron. The iron which I have used there is very low in silicon. In our works, at the present time, we are running nothing higher. I mean to take different degrees of silicon and carry on experiments with this. It may lead to some very valuable information. Regarding the question of expansion, I had a little variation from 1.50 to 2 per cent. in silicon in our iron. I noticed the higher the silicon the more expansion took place. I have tried a variation in the temperature of the iron, but I could not discover that that made any difference in the expansion, but I do believe that a soft iron would expand more than a hard one. If that is true, I do not see why some device cannot be arranged so that we can determine the grade of the iron. There are many ways in which it would be an advantage. Lots of times in foundry practice such a device could be used. In steel works, and with different metals and iron blast furnaces, I believe it could be utilized.

One gentleman asks if I really do take into consideration sulphur more than silicon. In our practice at our foundry we are melting at the present time fifty to seventy tons of iron every heat and day. We make molds for Bessemer work, and we are required to keep within Bessemer limits. We have to be most careful in not overreaching these specifications. We have silicon, sulphur and manganese in the iron. We cannot always get the iron we want, and we have to take something and get a mixture. When iron is low in silicon we take every precaution to know where the sulphur is. If the sulphur is up to .04 it would be very risky to attempt to use it in the iron that would be 1 50 in silicon.

Mr. Carver: Will your flux take the sulphur from the iron?

Mr. West: We use a limestone for the flux, and it assists in reducing the sulphur, if we run a hot slag; but if we do not have a hot slag we must look out for trouble. Referring to Mr. Keep's statement that he can tell the construction of a casting by knowing the amount of silicon in it and the thickness of the casting, I have shown in my paper that this is wholly impracticable.

One gentleman asks something about the contraction in a cylinder vertically as compared to its diameter. Some years ago I carried on some experiments in that line. In practical work you cannot define it. In order to get at the question in a scientific way, I took two bars that were four feet long, and I molded them in a little iron flask which I designed especially with iron ends, so that when they would be up-ended the strain of the metal could not make any difference in the length of the mold. I molded two vertically and two horizontally. These were cast from the same ladle of iron, as quick as they could be poured, and there was no difference whatever. The iron contracted the same vertically as horizontally. I used a very thin gate, that I knew would solidify before the bar. I have the data in one of my works. I tried several experiments to satisfy myself that I was right. I am asked how I obtain the temperature. The only method I had for obtaining that was simply by referring to a paper which was read at the last meeting of the Mining Engineers. This paper gave the temperature of molten metal from dull as it can be poured to the hottest, and also gave the temperature of it as it solidifies. I simply accepted these data. Somebody asked how the brick molds were built. I could not answer that question. One gentleman refers to the matter of building loam bricks into a core, and that is the plan which I follow myself, not only with cylinders, but I find it necessary where very high vertical castings are made, to put in loam cores instead of bricks.

Mr. H. E. Bullock: In making your machine, do you make the side-bars of wood or of iron?

Mr. West: They are made of iron.

Mr. Bullock: If they were made of wood they would not expand, and would you not then get the expansion of the iron better? While the casting is cooling the bars of the machine are growing hotter all the time instead of growing cooler.

Mr. West: There is only one part that could have any effect at all on causing the results that some would ascribe. That is at the end. But we have the two bars side by side, and what is going to affect one bar is also going to affect the other.

On motion, duly seconded, a vote of thanks was extended to Mr. West and Mr. Keep for their papers of the evening.

The meeting then adjourned.

Personal.

John Tod, of the iron ore and pig iron firm of Tod, Stambaugh & Co., Cleveland, was appointed receiver of the New York, Pennsylvania & Ohio Railroad, by the court at Akron, O., Nov. 20. The appointment of a receiver is in furtherance of a plan by which the road is to become a part of the recently reorganized Erie road.

A portrait of Hon. Geo. S. King appears in the current issue of the *Bulletin*, with this memorandum: "Founder of the Cambria Iron Works in 1852, and now living at Johnstown, Pa. Born at Hagerstown, Md., Oct. 28, 1809, 86 years ago, Mr. King is probably the oldest living American iron master. He is in good health."

John A. Dutcher, senior member of the foundry firm of J. A. & P. E. Dutcher, of Milwaukee, died suddenly at his residence, aged 66. He was born at Saulsbury, Conn., and at the age of 20 years went to Milwaukee. He was one of the best known of Milwaukee manufacturers and was highly esteemed.

Andrew Carnegie arrived in Cleveland Tuesday, Nov. 26, and in the evening attended the reception and banquet given in celebration of the 50th anniversary of the St. Andrew's Scottish Benevolent Society. Mr. Carnegie responded to the toast "Scotland," and Gov. McKinley to "Our Adopted Country." Mr. Carnegie was given an informal reception Wednesday afternoon by the Cleveland Chamber of Commerce and made a brief address. He ewas accompanied by Henry A. Phipps, Jr., his business associate of so many years, and by H. M. Curry, of the Carnegie Steel Co.

STRETCHING CAST IRON AND ELEMENTS INVOLVED IN ITS CONTRACTION.*

BY THOMAS D. WEST.

What shall I allow for contraction? is a question which the experienced pattern-maker will generally ask the molder or founder before any patterns of importance are begun. It is true, we have the stereotyped rule of allowing ⅛″ per foot for contraction and many pattern makers and founders are so inexperieuced as to accept such a rule for the construction of every form and thickness of a pattern which their plant may be called on to make. It is possible with the class of work which they make, that such a practice may never have led them into difficulties and hence they obtain an experience which would lead them to believe that there are no conditions calling for anything else than the making of all patterns ⅛″ per foot larger in every direction than the castings desired.

Molders and founders of broad experience in general machinery work know that there will generally be a difference in the contraction on any two forms that differ in their proportions, even when poured with the same iron. Also the form of a mold and the manner in which it is made and the casting is cooled, have much to do with the size of the casting, as compared with the pattern from which it was made.

It is not the intention of the writer to attempt to set up any fixed rules for the contraction of castings by the classification of the different kinds of work, as some have done, for this is not practical, but more to call attention to the principles involved and assist the engineer, founder, molder and pattern-maker to best judge what contraction, if any, should be allowed in constructing patterns, to meet the various conditions in molding, mixing of metals and cooling of castings. Not only has the experienced heavy work founder found a great difference to exist in the contraction of the same kind of iron in different castings, but some will agree with the writer in affirming that instead of allowing for contraction, the reverse conditions occasionally prevail and are elements frequently necessary to be considered in making patterns. It is nothing unusual for molders and founders engaged in heavy or jobbing machinery, to find their castings to be larger than the patterns from which they were made, thus disclosing a condition in founding of which the light-work founder and "stove plater" would have no opportunity of attaining any knowledge. Before the writer will discuss the qualities involved in stretching cast iron, which is an important part of this paper, he will consider those effecting a difference in thick and thin bodies cast under the same conditions or in the same flask with the same iron or "gates" and from which observing founders have learned that a heavy casting or parts will contract much less than a light one, where conditions permit free contraction to take place.

An experiment which the writer conducted to demonstrate the above fact, was to take a pattern 14 ft. long x 4″ x 9″ and another exactly the same length but only ½″x 2″ and cast both together with the same gates. Although the bars were of the same iron a difference of ⅞″ existed between their contraction. The thin casting contracted 1¾″ whereas the thick one only went ⅞″. Why is this? is a natural question to be asked and in answer the writer would offer the following hypothesis:

The carbon in iron, while in a fluid state, exists in a combined form. How much of this will change to graphite when the castings or iron has solidified and become cold enough to handle, depends first upon the time of cooling, and second, the percentage of sulphur, silicon, manganese and phosphorus which exist in the iron. The greater the silicon up to about 4 per cent, also the phosphorus up to 1 per cent and the lower the sulphur and magnese, taking account also of the time consumed in cooling, the higher we will find the graphitic carbon. The greater the formation of graphite, the larger the molecules and grain of the iron, and here lies all the secret of thin castings and hard iron contracting more than thick castings and soft iron, in cases where all conditions in molding, cooling and freedom for contraction are substantially alike.

Two castings from one pattern, of the same iron, can by cooling one quicker than the other, be made to show considerable difference in their contraction, owing to the one having a greater time than the other to change the combined carbon to graphite. This quality the writer noted in a paper before the Foundrymen's Association at Philadelphia, last September, in which he also presented analysis of ½″ and 1″ square as well as 1⅛″ round test bars poured from the same ladle at the same time, showing that the graphite was much less in the ½″ than in the 1⅛″ test bars and on this account, contraction was much less in the larger than the smaller bars.

The formation of graphite may be compared to the raising of bread. The longer time given for the yeast to act, the greater the bulk of the dough obtained, caused by the expansion of the wheat's molecules. This is similar to the cooling of liquid iron to a solidified cold state. The longer the period for cooling, the greater the expansion of the molecules and grain of the iron, which is defined chemically by our having higher graphite in slow than in fast cooling, and which is also assisted by the affinity which the heaviest parts of a casting or that last to solidify posses in attracting silicon to have its percentage higher than will be found in the lightest portion or those first to solidify. A quality held to be true by several different experimentors and the writer.

We can take the worst kinds of scrap iron and by pouring them melted, into heavy bodies, as anvil blocks, for example, obtain iron that presents a large open-grained fracture often of excellent texture, proper for being readily machined, whereas, were the same iron poured into a casting under three inches in thickness, it would be "white" and hard as flint. In the former case, also, it would show much less contraction than in the latter. These facts will go to show that the length of time occupied in cooling a casting, after the molten metal has solidified, may often be more effective in causing different degrees of contraction and hardness of iron in a casting from ordinary gray foundry iron, than any varying percentages of sulphur, silicon, etc., which exist in ordinary foundry iron. Any one, giving due consideration to the points here raised, will be led to concede the impracticability of formulating set rules for the contraction of castings, to be published as a universal guide to desired results in the dimensions of castings; but by a study of the phenomena here referred to, we will be in a fair position to determine what allowance should be made for contraction, etc., when we are on the ground of action. It is to be understood that reference is not made to the difference which may exist in the size of like castings from soft and hard iron, or variations due to the hardness of ramming and head pressure of molten metal on molds, etc. We are simply dealing with the elements involved in the question of contraction, as affected by rapidity of cooling, stretching of iron, and variations in the thickness of metal, etc., in castings.

The theory was advanced at the last meeting of the American Society of Mechanical Engineers held in Detroit, that there are three states of expansion in solidified iron cooling down from molten metal, "freezing" to a solid state with atmosphere temperature. These three expansions are claimed to have been discovered by means of a novel device which Mr. Keep originated and which records what are called "Keep's cooling curves."

The manner in which this so-called discovery was presented by Mr. Keep elicited much surprise from all interested, both at home and abroad, and as far as the writer has been able to learn, has misled all as to the true cause of the effect recorded.

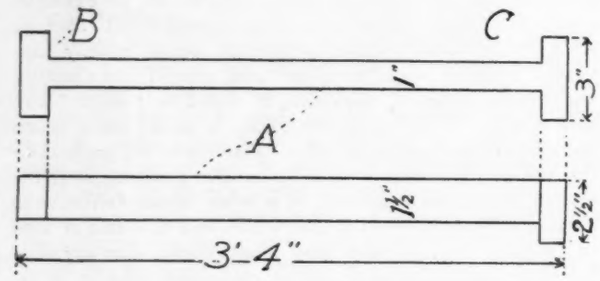
A large experience in general cast iron work causes the writer to assert that where full freedom is given for the iron to contract there are no such three states of expansion as Mr. Keep claims exist after molten iron has solidified, as was recorded by his so-called "cooling curves." The device as arranged by Mr. Keep puts a strain on the test bar when it commences to contract, and as the metal continues to draw together under the strain, it is stretched and occasionally recovers sufficient power to exert at intervals a pulling together or contracting effect. And thus, instead of recording an even steady contraction or straight line, as exists where full freedom is given, the device records erratic or uneven curves, according as the influence of contraction in the test bars gains the greater power over the resistance of the levers used in Keep's device (an illustration of which will be passed to the members.) The softer the iron the greater the effect in this direction. This is shown to be the case with the lines recorded in

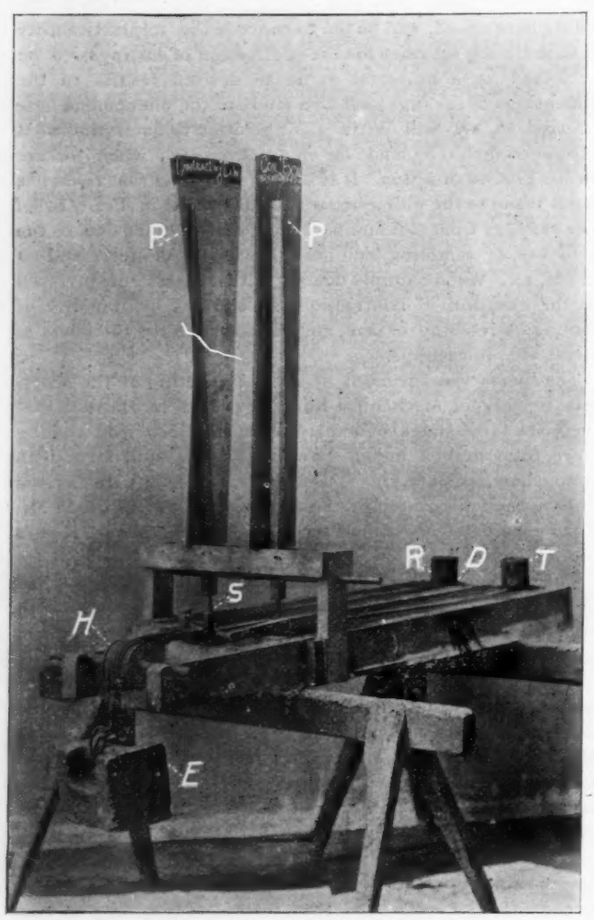
*Read at the meeting of the Western Foundrymen's Association at Chicago, Wednesday evening, Nov. 20, 1895.

Mr. Keep's experiment and confirms the writer in the position he has taken, in support of which he will also cite examples of expansion, stretching and cooling iron in heavy founding, to further prove the impracticability of Mr. Keep's device for proving there are three states of expansion in iron cooling after the molten metal has solidified.

Before going further, the writer would state that expansion in iron only takes place at the moment of solidification and is a natural quality which will evince itself in the direction offering the least resistance. "Stretching" is due to artificial influences exerted by conditions in casting, cooling and forms of patterns, to overcome or retard free contraction. It can makes castings larger than the patterns from which they were made, and also makes it possible to obtain acceptable castings which could not be secured were it not for the ability of iron to be stretched.

The writer will now describe a device which he has designed and originated to test and prove that Mr. Keep is in error in drawing the conclusions which he has from his apparatus for "cooling curves." While the cuts will explain clearly to some the exact working of the device, I will describe it in detail in order that all interested can criticise and fully understand its construction and action.





A is the pattern used. The shoulders at B and C are for the purpose of providing means to stretch the bar by clamping or holding one end to a support at D, which has a recess forming a part of the iron frame at the end D into which the projection X of the test bar pattern A is inserted when molding the bar, and which when cast rigidly prevents the test bar from contracting or pulling away from this end, the other end being pulled by weights as seen at H where one, two or more 50-lb. standard weights are suspended over the roller H. There are two molds cast side by side "open sand" with independent runners R and T from the same ladle of iron as quickly as they can be poured. The only difference existing in these two molds lies in one being strained by the weights, while the other is free from any weight or restraint to prevent contraction, other than the restraint of the mold's sides; and this affords the most favorable arrangement to observe and record any difference which may exist in the contraction, etc., of free and restrained bars. Independent pointers are attached to these bars by means of levers and show their readings on scales behind them.

The first movement of the pointer to be noticed is its passing to the right of zero. This action commences about 30 seconds after the bars are cast and continues for about 90 seconds for a total travel of the pointer of about one and one-half degrees on the arc shown over the top of the pointer P. This is caused by the expansion of the metal at the moment of solidification, a quality by the way, which some have disputed. After the expansion has fully recorded its influence in lengthening the bar, the pointer P stands still for about two minutes, after which time contraction begins and the pointer P starts to move back to the left. The weights at E are now suspended and it will be well to emphasize the fact that they exert no influence to suddenly move backward to zero the pointer P. Five minutes after the contraction commenced, the restrained bar's pointer will have moved about one degree and the pointer on the free bar 2½ degrees to the left of their starting points. About 15 minutes after the bars are poured, the restrained bar will have moved the pointer 1½ degrees and the free bar 3½ degrees. At 30 minutes after the pouring, the restrained bar will have moved the pointer three degrees, and the free bar about five degrees, showing in the interim, between 15 and 30 minutes after the pouring, that the restrained bar held about even pace with the free bar.

From this point on, the restrained bar keeps gaining on the free ber, until the end, when the free bar stands about 1½ degrees ahead of the restrained or weighted bar's pointer, thus showing we can restrict contraction by power and that the period of the greatest stretching of cast iron, cooling from a solidified state to the temper coldness of the atmosphere, wherever there is any restraint upon its contraction, is that ranging from 1600° F., to 1200° F., or in color from a light to a dark cherry. The reason for describing the above tests in the manner detailed is owing to the fact of a low silicon mixture being used with but two 50 lb. weights suspended to retard the contraction. Many other experiments were made as will be shown further on.

In closely watching the movements of the pointers of the restrained and free bars as they contract, a wavering, quick, forward (and often backward) motion, sometimes as far as ½ degree, will be plainly noticed in the restrained bar, while the free bar has a constant steady forward movement. The quick wavering motion is occasioned by the resistance to free contraction, which the weights offer to the bar and occurs when the contraction occasionally has sufficient power to overcome the influence of the weights to stretch out the cooling iron; and this same effect is produced in a similar manner by Mr. Keep's apparatus, but he has failed to give the true cause of the erratic curves or lines recorded by his device.

The fact that cast iron can be stretched is also often exemplified in heavy founding and in the cooling of castings, examples of which in every day practice the writer will cite further on. A factor which should not be lost sight of at this point is the positive manner in which the device here described demonstrates that there is a moment of expansion in molten iron cooling down to a solidified state. Wherever test bars are cast between rigid yokes or flask ends, a strain is put on the bar at the moment of expansion. It is a fact, moreover, that iron does expand at the moment of solidification. To demonstrate this by the device shown, it is necessary to cast one bar between fixed iron ends which cannot be moved apart by the strain of the expansion, and another bar which shall have the end at the pointer P free in the sand to record any expansion which may take place.

Any one experimenting in this manner will find that the bar left free to expand will move the pointer to the right of zero from one to two degrees, while the bar, cast between the iron

ends, or yoke, will not move the pointer until it starts to the left, thus showing that iron will expand if left free to do so.

The writer wishes to state that he will continue his expansion experiments and is of the faith that he has discovered, that with such a device as herein shown, he will eventually be able to utilize the expansion of metal to denote the grade of hardness, etc., in the short period of one minute after the molten metal has been poured. There are several ways in which such a quick determination of the grade, etc., of metals could be practically applied and prove of much value to the metallurgical world.

The writer could detail all the tests which he has made to show the movements of the pointers at every few moments, but as what he has given is in a practical sense all that is necessary to prove the theory advanced by this paper, such minute details have been omitted. Suffice it to say that the principles in expansion, contraction and stretching presented are not deduced from one or two experiments, but from a large number of tests, and that with a weight of 500 lbs. suspended at E and an iron of about 1.50 in silicon, .050 sulphur, he has made a difference of ¼″ in the final contraction of the free and restrained bars and is of the faith that with higher silicon or a softer iron he will be able to make the final stretching of the restrained bar to exceed that of the pattern A, which is 1″ by 1½″ and 3′ 4″ long over all as shown by the cut at A.

Returning to the subject of stretching cast iron, the writer will cite a few instances in every day heavy founding, that will assist further to demonstrate the existence of such a quality. As one illustration of this fact, I refer to the making of some large Martin pump castings with my own hands about 1879 at the Cleveland Rolling Mill Co.'s foundry in Cleveland. These were of a design requiring many large cores, and when the patterns were made the usual stereotyped contraction of ⅛″ per foot was allowed for the castings. I had made about four of these castings when I was one day pounced upon by the manager, who wanted to know what I had done to cause the castings (cope as well as nowel parts) to be larger than the patterns, which had caused a great loss in other smaller castings that would have to be made over in order to correspond in size to the different parts of the large pump casting. The investigation simply resulted in showing that the designer, draftsman and patternmaker were all ignorant of the qualities which exist in cast iron, permitting it to be stretched when cooling, after solidification has taken place.

It is natural to inquire as to the reason for the iron being stretched to such a large degree in these castings. The writer's hypothesis is that owing to the castings being filled with large cores containing both slim and thick cast and wrought core rods, as soon as the cores became heated they and all the rods expanded and by outward pressure which they exerted, overcame the resistence of the outer body of the green sand mold; and while the metal was in a fluid state, instead of shrinking, as is generally the case with heavy castings, some of it would actually flow back and run out over the flow-off gates. This action continued until solidification took place; then stretching of the half molten and "frozen iron" came in play, expanding all sides of the green sand mold until the force of the expanding cores and their rods gave way to that of the outer mold's body or metal, and the casting attained that point of cooling, as shown in the experiments illustrated with the writer's device in which it had cooled sufficiently to overcome the influence of the power most greatly exerted to stretch the iron.

Another illustration of stretching iron is found in the making of large loam cylinders, where, as is the case with some shops, they will "strip" the core so as to break the arch which the solid round brick work of the core presents to prevent free contraction. This, up to a very late day was common practice by all founders. I know of one firm, Wm. Tod & Co., of Youngstown, O., who are now making cylinders as large as seven feet in diameter and do not "strip" the core, and find no trouble from cracking, as was feared by all.

I would ask any in a position to try the experiment, to make one without "stripping" and one with it and see if there is not a difference in the contraction of the two castings. If all other conditions remain the same, a difference will be found, due to the ability of iron to stretch. But this should not be expected to the degree found in castings full of large cores, similar to those cited in the case of the Martin pumps, as with these the expansion of the cores exerted an outward pressure which did not take place with the cylinders. Again, the pump cores commenced their expansion before the metal had solidified, as was proven by the liquid iron oozing out of the "flow gates" and continued their enlargement long after the molten metal had solidified, thereby exerting an expanding power at a time when the cooling iron was most susceptible to stretching and which of course varies according to the thickness of a casting, its rate of cooling, etc, to obtain a temperature from 1,600° F. down to 1,200° F., as cited in the stretching tests with the apparatus above described.

The cases of the pump and cylinder, which have been cited, exhibits two forms of power, proper to be classed as expansion and compression resistance to contraction. We still have another form, which I will call heat resistance and which displays its power to stretch iron by reason of the carbon being more completely transformed to graphite under slow cooling. An example of this is an experiment which was made by a New York City founder some years ago.

The feat achieved by the founder was that of casting a balance wheel of about 18″ diam., having a rim about 2″ thick, with 4 to 6 arms only about ¼″ thick. The wheel was on exhibition for some time and the wonder of founders was how it held together. The writer was informed that the secret lay in a heating device, so arranged as to keep the arms at a high temperature and to preserve the temperature close to that of the rim, as the latter was cooled off. The writer would say that the feat was not achieved wholly by reason of extended heat, evolving greater graphite carbon in the arms. The element of stretching also assisted while keeping the arms hot, thus permitting the pulling power of the rim to extend them.

When we consider the difference that naturally exists in the contraction of light and heavy bodies, so clearly displayed in the test herein cited, of a 4 x 9 and ½ x 2 bar, it cannot but be evident that had the above wheel been left to cool off naturally the arms would have pulled away from the rim. This founder's achievement involves a lesson not to be forgotten by any interested in the founding or designing of machinery.

It is astonishing the ignorance which prevails on the question of contraction in cast iron. It is only the fact that cast iron will stretch, that saves many from having their ignorance on this subject exposed. There is hardly a piece of machinery casting made that would hold together were it not for the stretching property of cast iron. In this case as in all else in mechanics there is a limit to abuse, and it is not infrequently that we find this limit passed; but when it is, the poor founder is almost invariably held responsible for the results. When the casting cracks the designer is the last man upon whom there is any suspicion of blame, when in reality he most often is the one at fault.

The mechanical and metallurgical schools are continually striving to improve their curriculum so as to better fit the graduate for his life's work. The writer may be mistaken, but he has no knowledge that any graduate has been seriously impressed with the fact that light bodies of castings made from the same iron as heavy bodies would have the greater contraction. If this was learned, many seem to have forgotten it before leaving school halls or crossing the shop's threshold, as is evidenced to-day by the many disproportionate castings which can be seen wherever a judge casts his eye.

This is not to be taken as relieving the founder of all responsibility in the questions of cracked castings, etc. When the principles involved in the stretching and contraction of cast iron are understood, he can often, by methods of cooling and permitting freedom for contraction, do much to prevent disproportionate castings by relieving internal strains, which, if they do not rupture a casting before it leaves the founder's door, may often do so after it has gone into use. It must be remembered that there is hardly a piece of machinery but what has some part stretched, or held in strain, and if the latter is the case, we must often fear fracture or cracks, eventually causing injury of property and loss of life.

THE style and personnel of Emerson, Talcott & Co., Rockford, Ill., has been changed recently, by the retirement of the secretary, Mr. Talcott, Mr. Chas. Brantingham having been elected in his place, to the Emerson Mfg. Co. Mr. George Stanley has also lately become a member of the company.

PROPERTIES OF CAST IRON SHOWN BY KEEP'S COOLING CURVES.*

BY W. J. KEEP, DETROIT.

The shrinkage of a casting can be diminished by increasing its silicon or vice-versa. If a large and a small casting are made from the same iron, the large casting will shrink less than the small one. The shrinkage will vary with the percentage of silicon and with the size of the casting.

For any size of casting, the silicon can be proportioned to make the shrinkage ⅛″ per foot. Knowing the silicon in any iron mixture, and the size of the casting, the shrinkage can be computed by Keep's graphic shrinkage chart.

If a founder uses a ½″ square test bar to measure shrinkage, he finds that for the best quality of castings ⅛″ thick, the ½″ square test bar will shrink .125 or .130″ per foot. For the best castings 1″ thick, and with a shrinkage of ⅛″ per foot, the shrinkage of a ½″ square test bar will be .160″.

Example of the use of this chart: Two bars were cast in the same mold, with the same iron, from the same gates; one was ½″x2″x14 feet, the other 4″x9″x14 feet. The shrinkage of the smaller bar was .125″ per foot, and that of the larger bar was .062″ per foot. By Keep's chart the rate of cooling of the small bar is .20 and of the large bar 1.35 cubic inches contents divided by square inches in cooling surface. Extending the chart to a ratio 1.35 and finding the shrinkage .062″ brings us to the shrinkage line corresponding with 2.25 per cent. silicon. Following this line to the ratio .20 gives the shrinkage of the smaller bar .135″ if cast in a mold by itself, from the same iron as the larger bar. When, as in this case, the small bar is cast in the same mold with the large bar, and with the same gates, the heat from the large bar is carried through the gates and through the sand of the mold to the smaller bar, which decreases its rate of cooling until we find its shrinkage only .125″ per foot.

In casting a pulley with very heavy rim and very light arms, if heavy blocks of iron are cast at the same time with the pulley, so that they nearly fill the spaces between the arms, the rate of cooling of the arms is so reduced that they will not shrink enough to break. If a mold is correctly made, so that it will resist the ferrostatic pressure of the fluid iron, the shrinkage of every casting will be exactly what would be due to the silicon in the iron, and to the size of the casting, and every casting is always smaller than the mold. If the molder finds the casting larger than he expected, it is because the mold when it was filled with the fluid metal was larger than he expected.

The size of the grain in a casting depends upon the percentage of silicon, and upon the rate of cooling. The crystals take their final form and size after the iron has become solid, and at this same instant the carbon separates and falls into the spaces in the form of graphite. If the percentage of silicon in the casting is below 2.25 per cent., large castings will contain more graphite than small castings from the same iron, because the graphite separates slowly.

In castings with over 3 per cent. silicon, the small castings will often contain as much graphite as large castings, because all the graphite that can separate does so very rapidly. A slight variation in sulphur, phosphorus and manganese will not exert any perceptible influence upon the amount of graphite or upon the size of the grain. The size of the grain and the amount of graphite do not change after a certain definite temperature has been reached, but the shrinkage continues until the casting is cold. The relation between shrinkage and the percentage of silicon is definite for castings of a given size, and the variation in shrinkage on account of the rate of cooling is as definite.

The facts just enumerated were difficult to explain until the discovery of "Keep's Cooling Curves" in the early part of this year. A paper descriptive of these "curves" was read at the meeting of the American Society of Mechanical Engineers, at Detroit. A paper on the same subject was read in August before the Iron and Steel Institute, of London, and Mr. Gus. C. Henning described these "curves," and the work for the Mechanical Engineers' Testing Committee, at the meeting of the International Committee on Uniform Methods of Testing, which met at Zurich last summer.

These series of tests of cast iron are the most comprehensive and complete of any that have ever been made. The mechanical laboratories of Cornell University and of Case School of Applied Sciences were engaged six months in determining the physical properties of the square test bars, and the physical laboratory of Columbia College School of Mines has not yet completed the tests of the round bars of different dimensions cast flat and on end. At Detroit, one hundred or more engineers saw Keep's curve apparatus record one of these curves. A large number of these were familiar with testings, and Prof. Carpenter, of Cornell University, when in Detroit at a later date, saw curves made where every detail could be watched. The machine is of the simplest possible character, consisting of two arms 22″ long and 24″ apart, so that any change per foot in the length of the test bar is multiplied twenty times. The machine is practically frictionless, all sliding parts moving on rollers. The short ends of the arms are attached to the two ends of the test bar by steel pins. The sand is not rammed hard and it does not touch the machine. The gate is at the center of the bar, so that nothing except soft sand touches the test bar, which is free to expand or to shrink.

A fluid test bar or casting cannot exert any force in any direction except the pressure of a liquid. So long as the test bar remains liquid it might be quite full of solid grains and yet no expansion of individual grains could cause the whole bar to expand and grow larger. A casting or test bar must be a continuous solid, before any expansion or shrinkage can change its length.

This curve machine shows that in the sand mold, a test bar 1″ square becomes solid in about one minute, and this was proved by two trials with the same sized bar by removing the bars from the mold at the end of one minute when they were found to be solid. On becoming solid all bars expanded for about five minutes, then all bars began to shrink; after 12 minutes all bars again expanded and this expansion was greater in proportion as the silicon was greater. When this expansion ceased the graphite did not increase, and shrinkage continued until the test bar was cold. In bars 4 to 10 and 14 to 16 there were only two expansions and these bars were cast from a crucible. Bars 11 to 13 and 17 to 22 from cupola iron had three expansions. Each expansion occurred later in proportion as the size of the test bar was increased showing that each expansion took place when the test bar had reached a definite temperature. The amount of the third expansion was in proportion to the size of the grain. An analysis showed that the greater part of the graphite was deposited during the third expansion. In the test bar ⅛″ thick the third expansion occurred one minute after the bar was solid. In the 1″ square test bar it occurred 12 minutes after the bar was solid, and in the 4″ square bar it occurred two hours after it became solid.

Here are two distinct kinds of experiments: 1st, with varying composition, and 2nd, with a definite composition and varying size. The curves show these variations in every case. It is not usual to distrust an autographic record, and when a large number of autographic records agree that are taken under regularly varying conditions, it is considered that the record is correct.

If there was any question as to the freedom of the test bar to expand and contract in the mold, it is settled in favor of the correctness of the record, by curve 11a on page 18, (turn the page so that the edge is toward you). The 1″ square cast iron test bar from which curve 11 page 13, was obtained, was heated to a bright red heat, and was placed upon the machine and the curve 11a was described, which corresponds to the third expansion of curve 11. This bar was cooled in the open air, therefore the curve is shorter, but no restraint whatever was put upon the bar. The parts of the machine were perfectly free to move. The bar was in this case certainly solid. What was true of 11a must have been true of 11.

Among the first experiments made with the curve machine, was one to determine the effect of restraint upon a test bar. The size of test bar was ⅛″x1″x24″. Two sheets of tin 4″ square were placed in the mold so that the under ends would be a part of the test bar, and with the steel pins of the machine passing through them, the outer ends extended between the new wooden ends of the upper and lower parts of the flask which were clamped together as closely as possible,

*Read at the meeting of the Western Foundrymen's Association at Chicago, Wednesday evening, Nov. 20, 1895.

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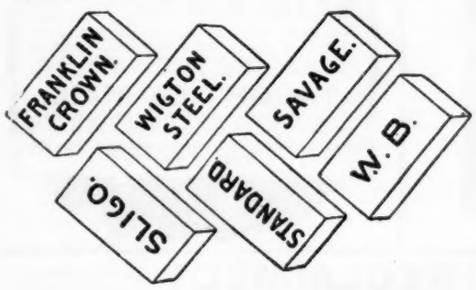

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the bar was poured with a ¾" round sprue set in the center of the bar. The bar, of course, became solid before any shrinkage could take place, and the ends being held rigidly in place when each half of the bar did shrink, a crack at the base of the gate was produced but it did not extend entirely across, because as soon as the gate became solid, the shrinkage pulled the sheets of tin from between the clamped ends of the flask far enough to destroy the smooth surface of the tin. The curve record showed the behavior of the bar at every instant.

It must be remembered that the power of a test bar to overcome resistance is equal to its tensile strength. The resistance of a sand mold can never be enough to overcome the tensile strength and cause surface cracks in a casting, provided that the size of a casting is uniform as is the case with a test bar.

The discovery of these cooling curves is of so much importance, that Columbia School of Mines placed both their chemical and physical laboratories at the disposal of the test committee.

A furnace has been constructed for reheating the test bars with the curve machine attached, so as to determine the temperature at which each part of the curve was made. This is being done by a Sechatelier and by a Simonds pyrometer. All of the test bars, made for the Mechanical Engineers' Test Committee, were made in yokes bedded in the sand one inch from the side of the bar, so that the ends of the bar would run against the inner ends of the yoke. On page six, of the paper read at Detroit, are curves taken from the ends of the yokes while a bar was made, also from each end of the test bar made in the yoke, and from a test bar made in sand without any yoke. These curves prove: 1st, that the chilling of fluid cast iron against cold iron is instantaneous; 2nd, that the yoke expands away from the ends of the test bar before it becomes solid; 3rd, that the yoke expands away from the test bar more than the bar can ever expand, and, therefore, that 4th, the test bar never touched the yoke after the mold was filled with metal. The test bars were therefore in every case perfectly free to expand and contract in every direction. The test bars from which curves were made were never cast in yokes.

Referring again to the fact that castings are often larger than the pattern: The I. P. Morris Foundry of the Cramps'

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Shipbuilding Co., of Philadelphia, were asked to measure the shrinkage of one of the cylinders of the steamship "St. Paul" which had just been lifted from the mold and which weighed 55,000 pounds. The answer of Mr. David Matlack, the foundry foreman, was: "It would be impossible to give the shrinkage on these cylinders now, for the reason that in large molds like these you never get the sizes exact to the drawings, for after they are built and dried, there is a considerable difference from the original mold. When we want the skrinkage on such a mold, we have to measure it after it is dried and in the pit, and even then it is not sure, for if the mold should strain in pouring say ½" and then the casting should shrink ½", in measuring you would be surprised to find no shrinkage.

OWING to increasing business, the C. F. Evans Steel & Iron Co., 50 Carew Bldg., Cincinnati, has deemed it best to become incorporated. C. F. Evans has been made president, and G. C. Dom secretary and treasurer. The new company will remove, Dec. 1, to more commodious quarters at 22 West Second street. It will continue the sale of hoop and band steel, wire nails, tacks, rivets, washers and manufactured specialties.

INDUSTRIAL SUMMARY.

New Buyers in the Market, and Some of Their Wants:—

[If you are in need of machinery of any description, please notify *The Iron Trade Review* and we will put you in communication with our advertisers at once.]

A. S. White, 926 Lafeyette st., New Orleans, will buy a 30-inch squaring shear for working sheet metal No. 18 and lighter, a 30 inch adjustable bar folder for sheet metal working, and a 10½-inch bench shear.

The Hamilton (O.,) Plow Works has been organized with a capital stock of $10,000. The firm has leased a building and will shortly commence operations. C. V. Parrish, Charles E. Heiser, F. K. Black and other are actively interested.

Sealed proposals will be received at the Supervising Architect's office, Washington, D. C., until 2 P. M., Dec. 21, 1895, for all the labor and materials required for the steel and iron work (nearly 6,000 tons) of the 4th, 5th, 6th, 7th, 8th, 9th and 10th floors, and the roof, also the steel columns above 3rd floor and the framing of iron stairs, etc., of the U. S. Appraiser's, warehouse, New York.

The Barnes Mfg. Co. has been organized at Mansfield, O.,

with a capital of $100,000, for the purpose of manufacturing iron and brass pumps. The concern expect to be in operation by Feb. 1, 1896. The buildings, consisting of a foundry and machine shop, engine and boiler plant, etc., are already under way. F. R. Barnes, formerly secretary of the Humphreys Mfg. Co., of Youngstown, is secretary.

New Construction:—

The Hughes Shear Co., Clyde, O., whose plant was recently destroyed by fire, has reorganized under the firm name of the Clipper Shear Co. The factory has been rebuilt and equipped with the latest improved machinery.

The new plant of the Whitman Agricultural Co., at Carondelet, Mo., is about completed. The machine shop will be 130x67 feet; the foundry, 130x70; the blacksmith shop, 60x100 feet, and the erecting shop, 130x60 feet.

The Louisville, Evansville & St. Louis Road is to build new shops at Princeton, Ind. Work is to begin at once on the main building, which will be 80x300 feet. These will be the main shops and will be equipped with modern machinery. It is intended to build freight cars and do general repair work.

The new railroad shops of the Southern Railway, at Alexandria, Va., will consist of seven buildings—a round house to accommodate 25 locomotives; a 100x160 foot repair shop; a 90x60 foot car shop; a 90x160 foot wood-working shop; a 90x160 foot boiler shop; a store house 40x240 feet, and a machine shop 90x160 feet. These buildings will all have steel frames and will be covered with galvanized iron. Work will begin at once.

The Keystone Axle Co., which will erect a new plant at Beaver Falls, will manufacture axles and car wheels by a patented process which will dispense with the use of a steam hammer and other ponderous machinery, and substitute a roller process which, it is claimed, will increase the tensile strength of an axle from 8,000 to 10,000 pounds to the square inch. The plant will be 800x200 feet in size and will contain a full equipment of machinery.

Additions, Enlargements, Removals, Etc.:—

Skow Bros., of Newton, Ia., are building an addition to their foundry.

The Birmingham (Ala.), Engine Works are building an addition, 100x250 feet, to contain new and improved machinery, etc.

Stanley Works, New Britain, Conn., have contracted for the erection of an addition to their plant, 51x139 feet, four stories and a basement. This building will furnish needed storage and shipping facilities and permit the installation of more machinery in their main building.

The Union Malleable Iron Co., of Moline, Ill., is now operating two large foundries, having two furnaces of a melting capacity of 22 tons a day. It will add another foundry and furnace before the end of the year, increasing its capacity 50 per cent. A complete machine shop is run in connection with the works. Malleable castings for carriages, wagons and agricultural implements, Heald's patent gear link drive chain and saw mill specialties are manufactured.

General Industrial Notes:—

The Akron Steam Forge Co.'s plant, at Elwood, Ind., is temporarily closed down for repairs.

At Anniston, Ala., the United States Car Co. is about to repair and improve its rolling mill, overhaul the car works and put the entire plant in operation.

At Indianapolis the manufacturers of the Waverly bicycle are increasing their facilities by the erection of five buildings, which will be equipped with latest bicycle machinery.

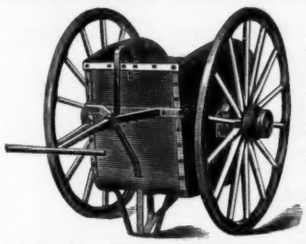
The cold roll department of the American Tinplate Works, at Elwood, Ind., is again in full operation, and some of the strikers have lost their places through the introduction of new men.

At the National Cash Register Co.'s works and the works of the Davis Sewing Machine Co., at Dayton, O., electric motive power is being introduced, each lathe, drill, etc., having its own motor.

At Anderson, Ind., the strike in the cold roll department is over. The 110 employes objected to the promotion of two American workmen, but finally yielded their point. The plant has not yet been started up.

At the South Chicago works of the Illinois Steel Co., the October production was 54,166 tons of ingots, and 41,686 tons of

Steel Ore or Charging Cart



This cart is largely taking the place of the charging barrows and is used in place of them by the newest and best equipped plants. The weight of the load is directly on the axle and is very easily dumped. Owing to the large diameter of the wheels, the large load is easily carried. Body made of No. 8 steel, banded around top with ⅜x1½ in. iron. To stiffen sides and support axle, a ¼-in. steel sheet 12x24 in., and a ⅜-in. steel sheet 6 in. square is securely riveted to inside of body. The axle passes through the center of each sheet and through the cart, and is riveted to body by iron hangers.

A steel shield is riveted to body over axles to prevent dirt from getting into the wheel-boxes and cutting them. Wheels—First quality wagon wheels 48 in. in diameter, painted, striped and varnished; 1½x½-in. tire; 14 spokes. Axles—Steel 1¾ in. square. Body—Width, 24 in., height, 33 in.; ngth, 40 in. Handle—1⅜-in. iron. Legs and Braces—⅜x1½-in. and ½x1½ in. Weight, complete. bout 540 lbs. Telegraph name, Slate.

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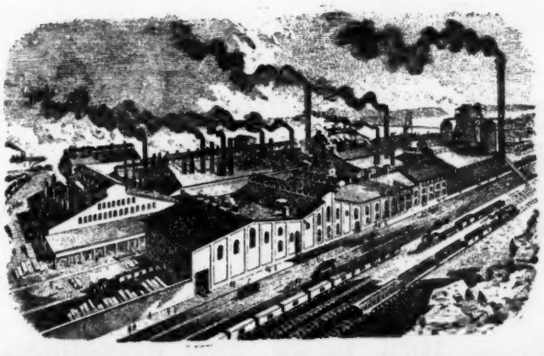

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rails. There were rolled direct from ingots 4,935 tons of plates, the best work yet done from ingots.

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A new company, promoted by Leonard Clark, of Pittsburg, proposes to establish at New Castle, Pa., a plant to turn out railroad specialties, such as nut locks, brace bars, hammers and other patented articles. The patentee is O. A. Wylie, who for 10 years was general manager of the Verona, (Pa.) Tool Works.

The McCormick Co., of Harrisburg, will hereafter be known as the Paxton Iron & Steel Co. It is one of the oldest in Central Pennsylvania and owns several furnaces, among them the Paxtons at Harrisburg and the Swatara furnaces at Union Deposit, in addition to the Paxton rolling mills and a puddle mill and a nail factory at West Fairview.

Phillips & McLaren have succeeded to the Fisher Engine, Foundry & Machine Works, carried on by the late William Fisher, Pittsburg. Mr. Phillips formerly had charge of the business department, and Mr. McLaren of the mechanical department. The firm will continue to manufacture bar, guide, sheet and plate shears, engines, rods, lathes, machinery and castings for mills, steel works, etc.

The Morton Tin Plate Co., Cambridge, O, is prepared to furnish extra large sizes of black plates for tinning, for the manufacture of vapor stoves, and other purposes which require extra smooth sheets. The size has been increased to 28x40 inches, annealed to any required temper, resquared to exact sizes. The company has purchased machinery to produce circles up to 24 inches diameter from either Bessemer or Siemens steel, black or tinned.

The New Castle Steel & Tin Plate Co. is making extensive improvements. The company recently began to erect a new building for an electric plant, and will have its own dynamos for furnishing light and power for the works. Wm. Sellers & Co., of Philadelphia, are putting a 15-ton crane in the hot rolling department, and are erecting a 10-ton crane in the cold rolling department. Eight of the new furnaces are now under headway in the heating department. The three new engines have arrived. They are of the Corliss make, and two will be used in the hot rolling department. These engines are each 900 horse-power, and the other, a 600 horse-power engine, will be erected in the cold rolling department.

OHIO DAYS' EXCURSIONS

To Atlanta Exposition at Special Low Rates via the Pennsylvania Lines.

Special low rate tickets to Atlanta will be sold via Pennsylvania Lines on Monday and Tuesday, Dec. 2nd and 3rd, account Ohio Days' festivities which will be held on the 4th and 5th of December at the Cotton States and International Exposition. Excursion tickets will be good returning ten days from date of purchase. For rates and time of trains please apply to any ticket agent of these lines, or C. L. Kimball, Ass't Gen'l Pass'r Ag't, 149 Superior st., cor. Bank st.

EXCURSION SOUTH.

Lower Rates to Atlanta via Pennsylvania Lines.

Three forms of excursion tickets to Atlanta account the Cotton States Exposition are for sale via Pennsylvania Lines. One ticket is good returning 20 days from date of sale, another is good for return trip until January 7, 1896, and a third good returning 10 days. Twenty day tickets and those good to return until Jan. 7 may be obtained any time during the Exposition. The 10 day tickets will be sold only on Oct. 26, Nov. 5, 15 and 25, and Dec. 5 and 16, at special low rates. The fare is exceptionally cheap. For details, apply to nearest ticket agent of Pennsylvania Lines or address C. L. Kimball, Ass't Gen. Pass. Agent, 149 Superior street, Cleveland, O.

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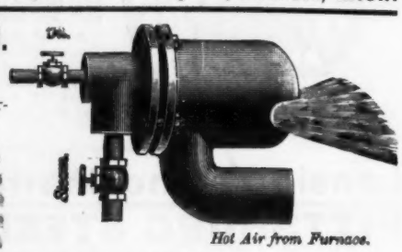

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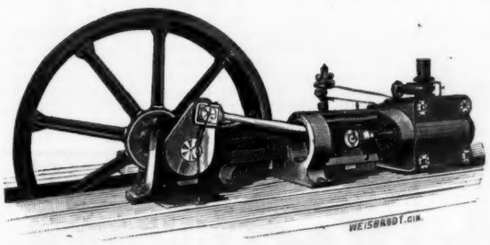

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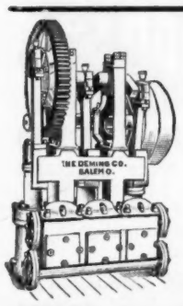

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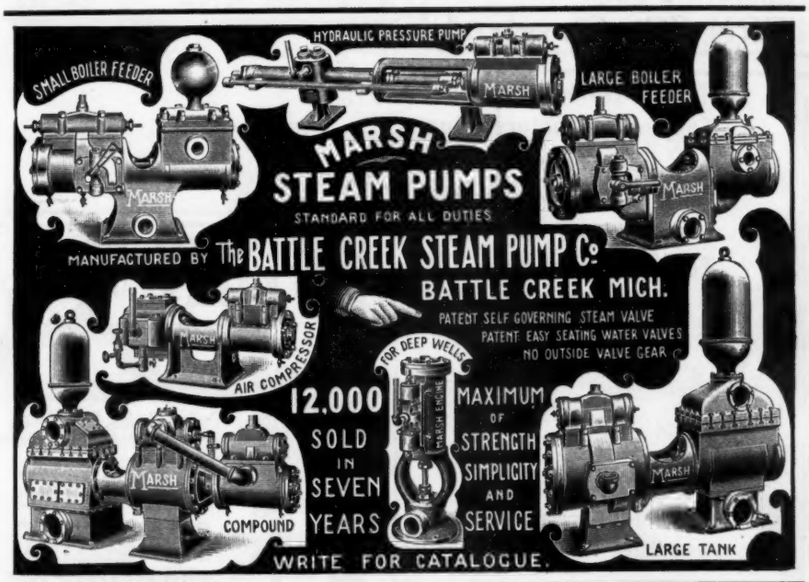

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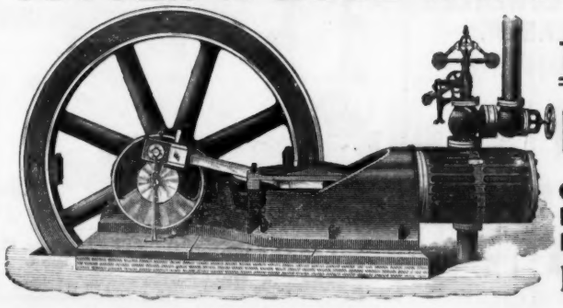

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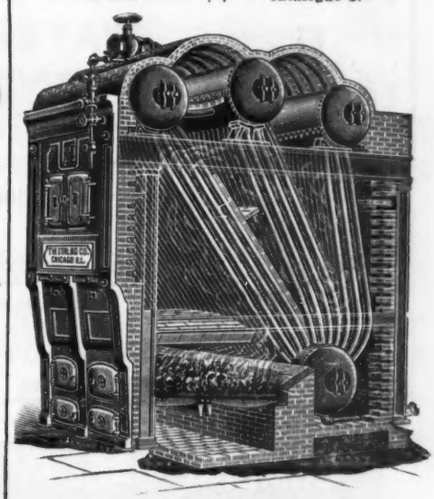

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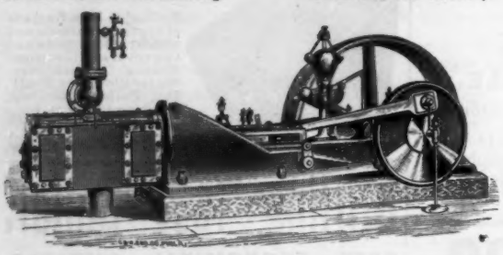

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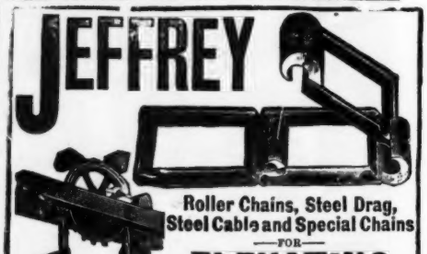

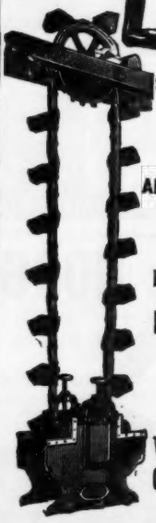

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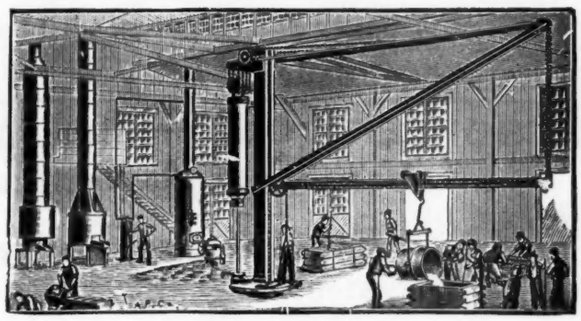

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With it the same moulders for the same wages can do 50 per cent more work than with any other Crane.

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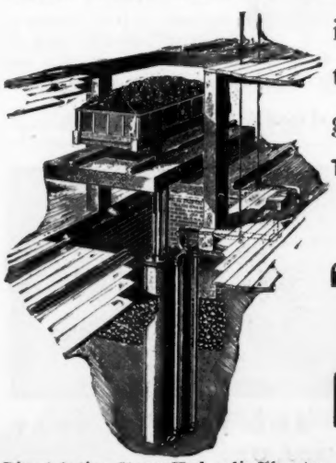

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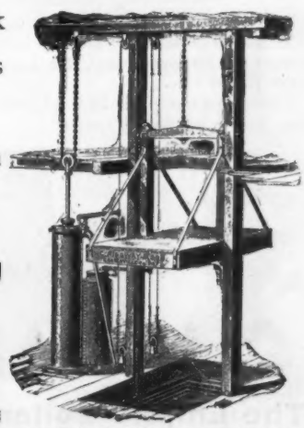
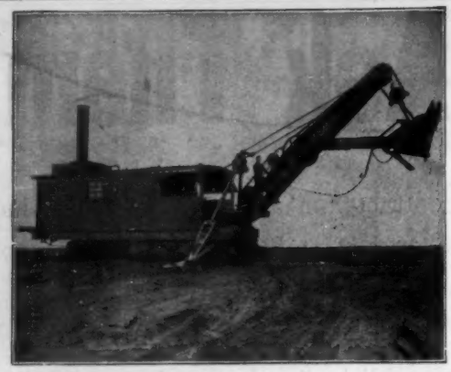


Steam Hydraulic Elevator, also made direct acting with cylinder under platform.



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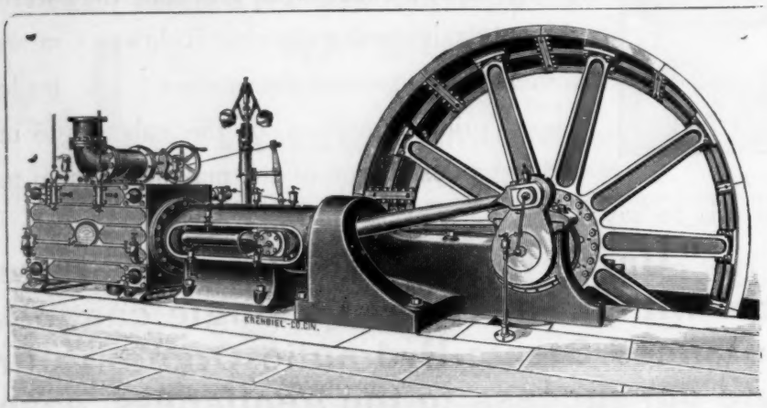

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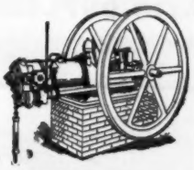

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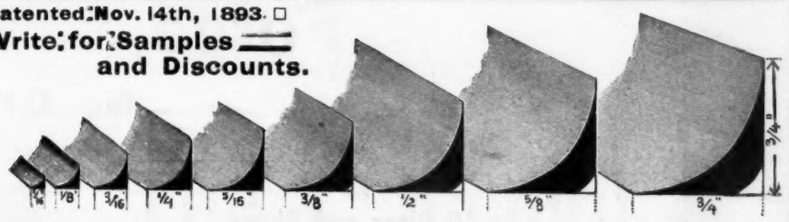

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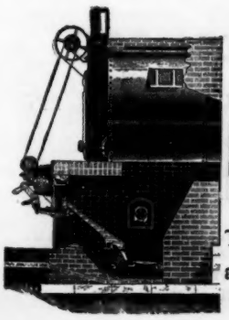

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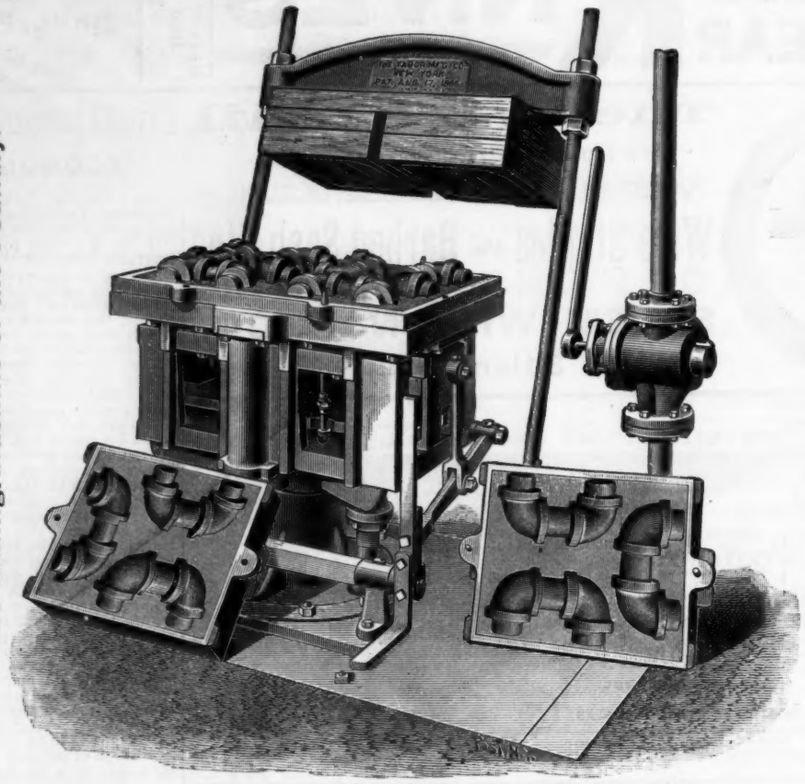

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These machines are adapted to general castings when made in reasonable quantities.

The use of these machines is a guarantee of economy, greater quantity and better quality in castings.

Foundrymen who are interested in producing cheap castings of superior quality are invited to correspond with the Company and call at the works, Front and Franklin Streets, Elizabeth, N. J., and see the machines in operation.

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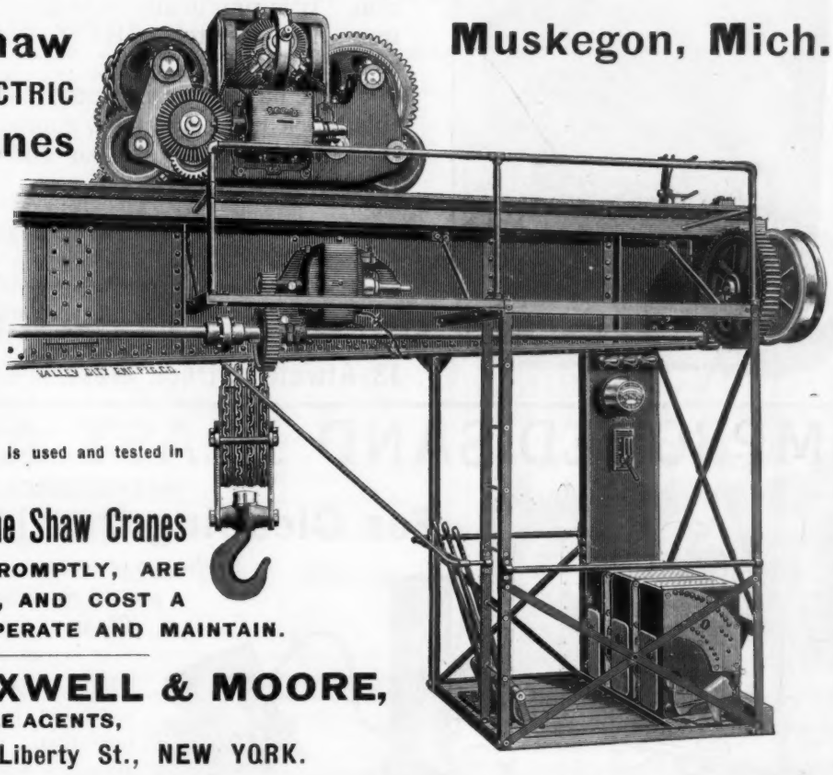

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It is Demonstrated that the Shaw Cranes

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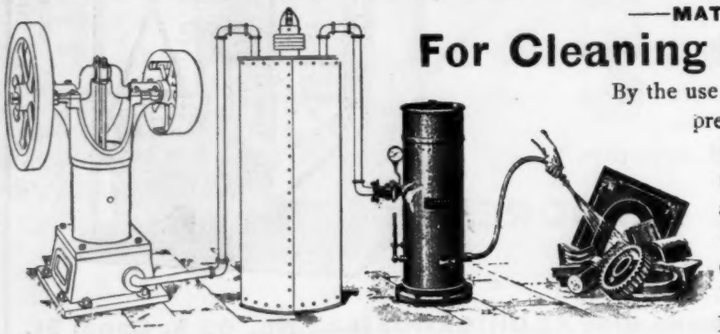

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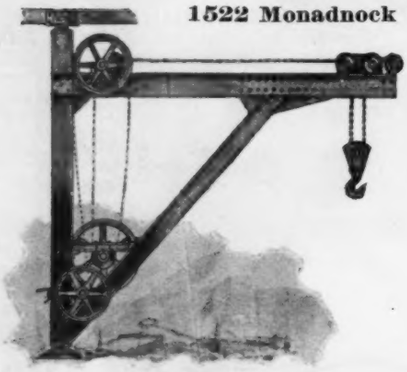

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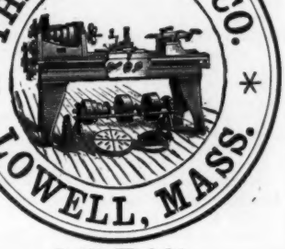

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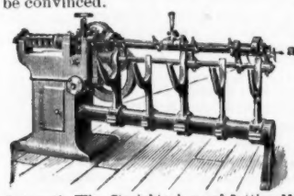

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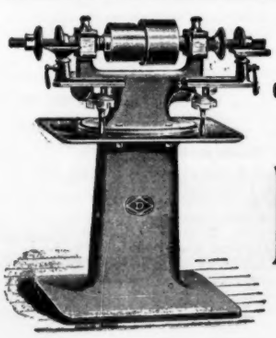

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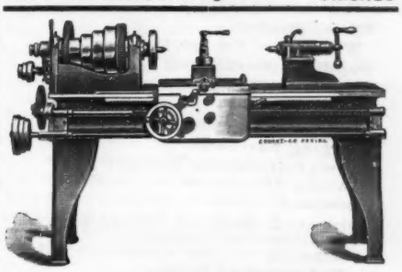
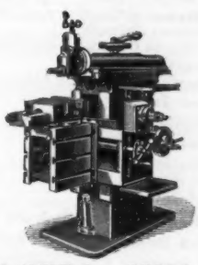


LATHES,



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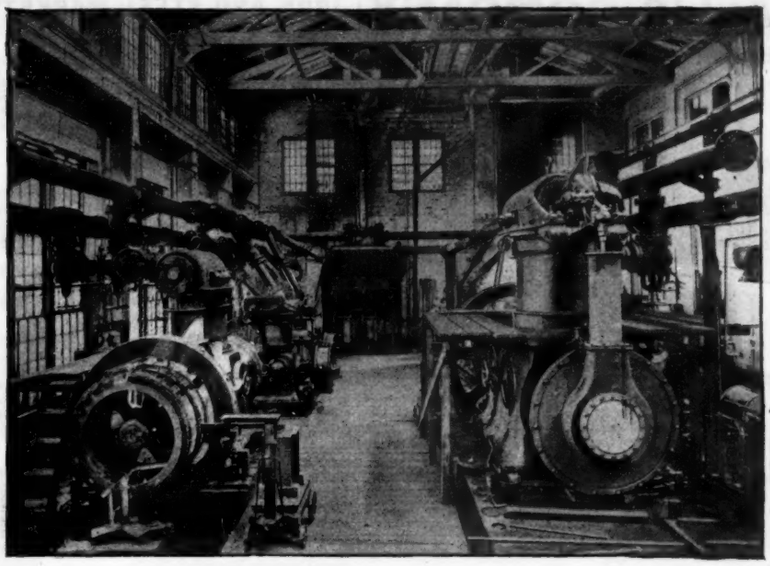

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Illinois Screw Co., Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.

Machine Shops—
Toledo Machine & Tool Co., Toledo, O.
Hamilton Fdy. & Machine Co., Hamilton, O.

Magnesia Covering—
C. H. Besly & Co., Chicago, Ill.

Manufacturers' Advertising—
United States Mailing Co., Cleveland, O.

Mechanical Engineers—
John Fraser, Chicago, Ill.

Metal Saws—
Q. & C. Co., Chicago, Ill.

Milling Machines—
Prentiss Tool & Supply Co., Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.
Lodge & Shipley Machine Tool Co., Cincinnati.

Mining Machinery—
Bucyrus Steam Shovel & Dredge Co., Bucyrus, O.
Vulcan Iron Works Co., Toledo, O.
C. H. Besly & Co., Chicago, Ill.
W. A. Crook & Bro's Co., Newark, N. J.
The Edward P. Allis Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Willis Shaw, 416 N. Y. Life Bldg., Chicago.
Link-Belt Machinery Co., Chicago, Ill.

Moulding Sand—
Ohio Sand Co., Conneaut, O.

Molding Machines—
Tabor Mfg. Co., New York City.

Nickel—
Canadian Copper Co., Cleveland, O.

Oil Cups—
C. H. Besly & Co., Chicago, Ill.

Oil Pumps—
C. H. Besly & Co., Chicago, Ill.

Ore Crushers—
The Edward P. Allis Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.

Packing—
C. H. Besly & Co., Chicago, Ill.

Paint—
Iron Clad Paint Co., Cleveland.
Jos. Dixon Crucible Co., Jersey City, N. J.

Pattern Letters—
H. W. Knight & Son, Seneca Falls, N. Y.

Pattern Leather Fillet—
Canton Leather Fillet Co., Canton, O.

Pattern Works—
Gobeille Pattern Co., Cleveland, O.

Perforated Sheet Metal—
Harrington & King Perforating Co., Chicago, Ill
Aitchison Perforated Metal Co., Chicago.

Pipe Covering—
C. H. Besly & Co., Chicago, Ill.

Planers—
Prentiss Tool & Supply Co., Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.
Lodge & Shipley Machine Tool Co., Cincinnati.
U. Baird Machinery Co., Pittsburg, Pa.

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Portable Forges—
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C. H. Besly & Co., Chicago, Ill.
B. F. Sturtevant Co., Boston, Mass.

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Cady Mfg. Co., Cleveland, O.
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.

Pulleys—
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Link-Belt Machinery Co, Chicago, Ill.

Pulley Blocks—
Moore Mfg. & Foundry Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Willis Shaw, 416 N. Y. Life Bldg., Chicago.

Pumps (Steam)—
W. G. & G. Greenfield, East Newark, N. J.
Battle Creek Steam Pump Co., Battle Creek, Mich.
Deming Co., Salem, O.
The Edward P. Allis Co., Milwaukee, Wis.
Willis Shaw, 416 N. Y. Life Bldg., Chicago.

Pump Regulators—
Valley Iron Works, Williamsport, Pa.

Pyrometers—
Edward Brown, Philadelphia, Pa.
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Rock Breakers—
American Hoist & Derrick Co., St. Paul, Minn.

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Totten & Hogg I. & S. F'dry Co., Pittsburg, Pa.

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Roofing (felt)—
Consolidated Roofing Works, Columbus, O.

Roofing Plates—
Morton Tin Plate Co., Cambridge, O.

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The Lloyd-Booth Co., Youngstown, O.

Sand Blast Machines—
Ward & Nash, Chicago, Ill.

Saws—
Peter Gerlach & Co., Cleveland.

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Robt. Aitchison Perforated Metal Co., Chicago.
Harrington & King Perforating Co., Chicago.

Scrap Iron & Steel—
Klein & Cohn, Cincinnati, O.

Screws—
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C. H. Besly & Co., Chicago, Ill.

Second-Hand Machinery—
Prentiss Tool & Supply Co., Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.

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Long & Allstatter Co., Hamilton, O.

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Berger Bros., Philadelphia, Pa.
Ætna-Standard Iron & Steel Co., Bridgeport, O.

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American Smokeless Furnace Co., Cleveland, O.
Brightman Furnace Co., Cleveland, O.

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Cady Mfg. Co., Cleveland, O.

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Wm. B. Scaife & Sons, Pittsburg, Pa.

Stamping and Punching—
Cady Mfg. Co., Cleveland, O.

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Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.

Steam Pipe and Boiler Covering—
C. H. Besly & Co., Chicago Ill

Steam Packing—
C. H. Besly & Co., Chicago, Ill.

Steam Shovels and Dredges—
Bucyrus Steam Shovel & Dredge Co., Bucyrus, O
Vulcan Iron Works Co., Toledo, O.

Steam Specialties—
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Wm. Jessop & Sons, Ltd., New York, N. Y.

Steel Castings—
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Potter & Hollis Foundry Co., Chicago, Ill.

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Samuel Tretheway & Co., Pittsburg, Pa.

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Cleveland Rolling Mill Co., Cleveland.
Bethlehem Iron Co., South Bethlehem, Pa.

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Wm. B. Scaife & Sons, Pittsburg, Pa.

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Cleveland City Forge & Iron Co., Cleveland.
Central Iron & Steel Co., Brazil, Ind.

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Enterprise Boiler Co., Youngstown, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.

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Universal Telephone Co., Indianapolis, Ind.

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The Lloyd-Booth Co., Youngstown, O.

Tin Plate—
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Morton Tin Plate Co., Cambridge, O.
Atlanta Steel & Tin Plate Co., Atlanta, Ind.
Ætna-Standard Iron & Steel Co., Bridgeport, O.

Torches—
Dangler Stove & Mfg. Co., Cleveland, O.

Tool Steel—
Wm. Jessop & Sons, Ltd., New York, N. Y.
C. H. Besly & Co., Chicago, Ill.

Tube Welding—
S. Fix Sons, Cleveland.

Twist Drills—
Cleveland Twist Drill Co., Cleveland.
C. H. Besly & Co., Chicago, Ill.

Valves—
C. H. Besly & Co., Chicago, Ill.

Ventilating Fans—
American Blower Co., Detroit, Mich.

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Akron Cultivator Co., Akron, O.
Lansing Wheelbarrow Co., Lansing, Mich.

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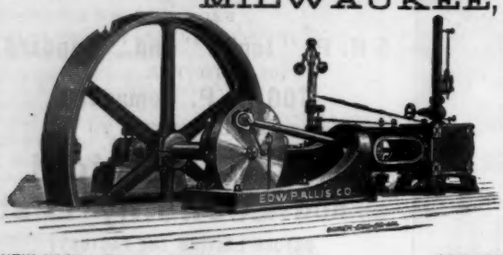
Salem Wire Nail Co., Salem, O.

Wire Rope—
W. A. Crook & Bro's Co., Newark, N. J.
American Hoist & Derrick Co., St.

Wire Machinery—
Cady Mfg. Co., Cleveland, O.
John Adt & Son, New Haven Conn.

THE EDWARD P. ALLIS COMPANY

MILWAUKEE, WIS.



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Reynolds Patent Vertical Boilers.

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CHICAGO, Room 509, Home Ins. Bldg
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PITTSBURG, 702 German National Bank Bldg.
SALT LAKE CITY, Desert Bank Bldg.
KANSAS CITY, Armour Bldg.

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The Industrial Centre of Chicago

offers Free Factory Sites and other inducements.

If you are seeking a new location it will pay you well to investigate the merits of our proposition.

Chicago Heights Land Association

M. H. KILGALLEN, Gen'l Mgr. CHICAGO

IRON AND STEEL MARKETS.

IRON ORE.

[On Lake Erie docks.]

No. 1 Specular, Bessemer	$4.75@ 5.25
No. 1 Bessemer hematite	4.25@ 4.50
Hematites No. 1 non-Bessemer	2.50@ 3.00
No 1. Specular, non-Bessemer	3.00@ 3.50

PIG IRON.

CLEVELAND (f. o. b. cars):

Bessemer	$13 50@ 13 75
No. 1 Strong Foundry	14 75@ 15 25
No. 2 Strong Foundry	14 25@ 14 75
No. 1 Gray Forge, red short	12 75@ 13 00
No. 2 Gray Forge, neutral	12 50
No. 1 American Scotch	15 00@ 15 25
No. 2 American Scotch	14 75
Lake Superior Charcoal	15 65@ 16 00

PITTSBURG:

No. 1 Foundry	$14 25@ 14 50
No. 2 Foundry	13 50@ 13 75
Gray Forge	12 75@ 13 00
White and Mottled	12 25@ 12 50
Warm Blast Charcoal	16 00@ 17 00
Cold Blast Charcoal	22 00@ 26 00
Bessemer	13 25@ 13 75

CHICAGO (reported by our representative:)

Lake Superior Charcoal	$15 50@$16 00
Local Coke Foundry No. 1	15 00@ 15 50
Local Coke Foundry No. 2	14 50@ 15 00
Local Coke Foundry No. 3	14 00@ 14 50
Local Scotch Foundry No. 1	15 00@ 15 50
Local Scotch Foundry No. 2	14 50@ 15 00
Local Scotch Foundry No. 3	14 00@ 14 50
Southern Coke No. 1	10 70@ 11 00
Southern Coke No. 2	14 00 .....
Southern Coke No. 3	13 65 .....
Southern No. 1 Soft	14 15 .....
Southern No. 2 Soft	13 90 .....
Southern Silveries No. 1	15 25@ 15 75
Southern Silveries No. 2	15 15 .....
Jackson Co. Silveries	15 50@ 16 00
Ohio Silveries No. 1	15 00@ 15 50
Ohio Silveries No. 2	14 50@ 15 00
Ohio Strong Softeners	15 00@ 15 50
Alabama Car Wheel	17 00@ 17 50
Malleable Bessemer	.....
Coke Bessemer	.....

CINCINNATI (reported by Rogers, Brown & Co.)

Southern Coke No. 1, Foundry	$13 00@$ .....
Southern Coke No. 2 and No. 1 Soft	12 75@ 13 00
Hanging Rock Coke, No 1	12 50@ 13 50
Hanging Rock Charcoal No. 1, Fdy	16 00@ 17 00
Tennessee Charcoal No 1	14 00@ 14 50
Jackson County Silvery No 1	14 00@ 15 00
Southern Coke, Gray Forge	12 50
" " Mottled	12 25@ 12 50
Standard Alabama Car Wheel	15 75@ 16 25
Tennessee " "	14 50@ 15 00
Lake Superior " "	15 50@ 16 50

BUFFALO (reported by Rogers, Brown & Co.)

No. 1 Foundry Strong Coke Iron Lake Superior Ore	$15 25@$15 75
No. 2 Foundry Strong Coke Iron Lake Superior Ore	14 75@ 15 25
Ohio Strong Softener No. 1	16 25@ 16 75
Jackson Co. Silvery No. 1	16 25@ 17 00
Lake Superior Charcoal	15 65
Southern Soft No. 1	15 15@ 15 65
Hanging Rock Charcoal	18 50

ST. LOUIS (reported by Rogers, Brown & Meacham):

Southern Coke No 1	$13 50@$13 75
Southern Coke No. 2	13 25@ 13 50
Southern Coke No. 3	13 00@ 13 25
Southern Gray Forge	13 00@ 13 25
Southern Charcoal No. 1	14 50@ 15 00
Missouri Charcoal No. 1	14 00@ 15 00
Ohio Softeners	16 00@ 17 00
Lake Superior Car Wheel	17 00@ 17 50
Southern Car Wheel	16 50@ 17 00

OLD RAILS AND SCRAP METAL.

	Gross Tons
Old iron rails	$16 50
Old steel rails	13 50
Old Car Wheels	11 50
	Net Tons
No. 1 R. R. wrought scrap	$14 00
Mill scrap	11 00
No. 1 Machine cast scrap	10 00
Iron axles	20 00
Axle turnings	9 50
Wrought turnings (free from cast)	8 50
Cast borings	7 50
Uncut wrought iron boilers	6 00
Steel boiler plates	11 50
Grate bars	6 50
Pipes and flues (clean)	9 50
Tank iron	9 50
Hoop and band iron	7 00
Sheet iron	7 00
Wrought drillings	8 00
Malleable iron	7 00

STRUCTURAL MATERIAL.

Beams and Channels (Cleveland mill)	1.70c@1.75c
Angles	1.60c@1.65c
Tees	1.75c@1.80c
Universal Plates	1.70c
Sheared Plates	1.80c

MERCHANT IRON AND STEEL.

[List prices out of store.]

Flat Bar.

1½ to 4 by ⅜ to 1 inch	1 60
4½ to 6 by ⅜ to 1 inch	1 65
1½ to 6 by 1⅛ to 2 inch	1 80
1¼ & 1⅜ by ⅜ to ¼ inch	1 65
1 & 1⅛ by ⅜ to ¼ inch	1 70
⅛, ¾, ⅞, by ⅜ to ½ inch	1 80

Frank P. Cady, Pres. and Supt.
Geo. H. Bowler, Sec'y and Treas.

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18, 20 and 22 Johnson St., CLEVELAND, O.

SEND FOR OUR NEW CATALOGUE OF Power Presses, Drop Hammers, Punches and Shears, Wire Working and Special Machinery.

PERFORATED METALS

OF ALL KINDS FOR

MILLING MINING AND AGRICULTURAL MACHINERY,

PERFORATED IRON, STEEL, COPPER, BRASS, TIN, ZINC, LEAD, ETC., TO ORDER.

LARGE AND VARIED ASSORTMENT OF SIZES. CORRESPONDENCE SOLICITED.

THE ROBERT AITCHISON. PERFORATED METAL CO.,

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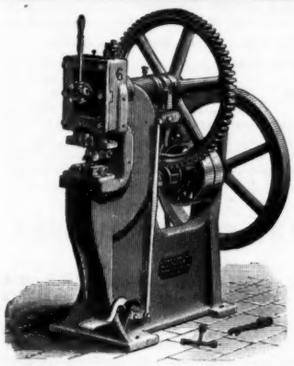

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Manufacturers of Belt, Steam and Electrically driven

POWER PUNCHES AND SHEARS,

for all kinds of Boiler, Tank and Structural Iron Work, Rolling Mills, Locomotive Shops, Car and Wagon Shops, Plow Shops, etc.

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Works and Mines, Westmoreland, Pa.

PL DIXON'S PERFECT LUBRICATING GRAPHITE.

The most Marvelous Lubricant Known.
Used Dry, or Mixed with Water, Oil or Grease

NOT AFFECTED BY HEAT, COLD, STEAM OR ACIDS.

An Interesting and Instructive Pamphlet will be sent Free of Charge.

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IRON CLAD PAINT CO.

Factory, 75 & 77 Central Way. Sec. & Treas., No. 3 Case Build'g,

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Trade Mark Patented.

ORDER DIRECT FROM THE

Iron Clad Paint Co.

And get the genuine article, and save liability of suit for using an article made in violation of the patents issued to Wm. Green, and now owned by this Company.

IRON CLAD PAINT is the most durable, most fire-proof and Cheapest Paint made.

FURNISHED both Dry and Ground in Oil

USED BY NEARLY ALL THE RAILROADS.

Round and Square.

1 to 1⅞ inch	1 60
2 to 2⅞ inch	1 80
2¼ to 3¾ inch	1 75
3⅜ to 4 inch	2 10
4¼ to 4½ inch	2 70
4¾ to 5 inch	2 90

Oval.

⅜ to 1¼ inch	1 80
⅜ to ¾ inch	1 80
½	2 00
⅝	2 20

Half Oval and Half Round.

1⅛ to 3 inch	2 15
⅜ to 1⅛ inch	1 95
⅜ to ¾ inch	2 20
½	2 35
⅝	3 45

Heavy Band.

1¼ to 6 by ¼ and 5-16 inch	1 70
1 to 1¾ by ¼ and 5-16 inch	1 75
¼ to ⅜ by ¼ and 5-16 inch	1 85
½ to ⅝ by ¼ and 5-16 inch	2 10

Hoop Iron.

1 7-16 to 4, No. 13, 14, 15 and 16	2 15
1 7-16 to 2, No. 17, 18 and 19	2 20
1 7-16 to 2, No. 20	2 30
1 7-16 to 2, No. 21	2 40
1 7-16 to 2, No. 22	2 50
1⅛ to 1⅜, No. 13, 14 and 15	2 20
1⅛ to 1⅜, No. 16, 17 and 18	2 25
1⅛ to 1⅜, No 19 and 20	2 30
1⅛ to 1⅜, No. 21	2 40
1⅛ to 1⅜, No. 22	2 50
15-16 and 1 inch, No. 13, 14 and 15	2 15
15-16 and 1 inch, No. 16, 17 and 18	2 30
15-16 and 1 inch, No. 19 and 20	2 40
15-16 and 1 inch, No. 21	2 50
15-16 and 1 inch, No. 22	2 60
⅞, No. 13, 14 and 15	2 40
⅞, No. 16, 17 and 18	2 50
⅞, No. 19 and 20	2 60
⅞, No. 21	2 70
⅞, No. 22	2 80
13-16, No. 13, 14 and 15	2 50
13-16, No. 16, 17 and 18	2 60
13-16, No. 19 and 20	2 70
13-16, No. 21	2 80
13-16, No. 22	2 90
¾, No. 13, 14 and 15	2 60
¾, No. 16, 17 and 18	2 75
¾, No. 19 and 20	2 85
¾, No. 21	2 95
¾, No. 22	3 05
11-16, No. 13, 14 and 15	2 85
11-16, No. 16, 17 and 18	2 90
11-16, No. 19 and 20	3 00
11-16, No. 21	3 10
11-16, No. 22	3 20
11-16, No. 23	3 30
⅝, No. 13, and 15	2 90
⅝, No. 16, 17 and 18	3 00
⅝, No. 19 and 20	3 10
⅝, No. 21	3 20
⅝, No. 22	3 30
⅝, No. 23	3 40
9-16, No. 13, 14 and 15	3 10
9-16, No. 16, 17 and 18	3 20
9-16, No. and 20	3 30
9-16, No. 21	3 40
9-16, No. 22	3 50
9-16, No. 23	3 60
7-16 and ½ inch, No. 13, 14 and 15	3 30
7-16 and ½ inch, No. 16, 17 and 18	3 40
7-16 and ½ inch, No. 19 and 20	3 50
7-16 and ½ inch, No. 21	3 60
7-16 and ½ inch, No. 22	3 70
7-16 and ½ inch, No. 23	3 80
⅜, No. 13, 14 and 15	3 80
⅜, No. 16, 17 and 18	3 90
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⅜, No. 21	5 31
⅜, No. 22	4 40
⅜, No. 23	4 55

Light Band.

1¼ to 6 by ⅛ to 3-16 inch	1 90
1¼ to 6 by Nos. 11 and 12	1 95
1 to 1¾ by ⅛ to 3-16 inch	1 95
1 to 1¾ by Nos. 11 and 12	2 00
⅞ and 13-16 by ⅛ to 3-16 inch	2 10
⅞ and 13-16 by Nos. 11 and 12	2 15
¾ and 11-16 by ⅛ to 3-16 inch	2 20
¾ and 11-16 by Nos. 11 and 12	2 25
⅝ and 9-16 by ⅛ to 3-16 inch	2 35
⅝ and 9-16 by Nos. 11 and 12	2 40
½ by ⅛ to 3-16 inch	2 50
¼ by Nos. 11 and 12	2 55

Wagon Box Iron.

⅞ inch, beveled edge, by Nos. 11 and 12	2 10
⅞ inch, " " " " 13 and 14	2 20
¾ inch, " " " " 11 and 12	2 25
¾ inch, " " " " 13 and 14	1 55

Sheet Iron.

No. 10	2 10
No. 12	2 20
No. 14	2 25
No. 15-17	2 35
No. 18	2 50
No. 20	2 65
No. 22-24	2 75
No. 25-26	2 85
No 27	2 95

Steel Boiler Plates—1-4 in. and Heavier.

Tank	2 00
Shell	2 15
Flange	2 25
Marine Flange	2 60
Fire Box	3 70

Above includes plates 90 inches wide.

90 to 96 in. wide	⅛c. lb. extra
96 to 100 in. wide	1 c. "
100 to 104 in. wide	1⅛c. "
104 to 106 in. wide	special

American Cast Tool Steel.

ROUND, SQUARE AND OCTAGON.	cts. lbs.
1 to 2 in. inclusive	08
9-16 to ⅞ in. "	08⅛

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MANUFACTURERS OF

TIN AND TERNE PLATE, Iron and Ste Plates and Sheets, Plain Black, Painted, Corrugated and other forms of ROOFING, SIDING and CEILING. Patent Leveled Galvanized Sheets, BARS, Light Section Rails, ANGLES, Tees, Channels, and other Miscellaneous Bars and SHAPES.

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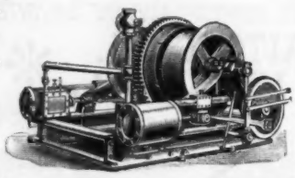

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Fixed Carbon	93.625	Ash	05 004
Volatile Matter	00.494		

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HOLMES, STRACHAN CO., Agents. Detroit, Mich.

Oak Hill Fire Brick & Coal Co., Manufacturers, OAK HILL, OHIO.

7-16 to ⅜ and 2⅜ to 3 in	.09
3⅜ to 4 in	.09½
⅜ to 11-16 and 4⅜	.10
⅛ to 6 in	.10¼
⅝ to 9-32 and 6⅛ to 7 in	.11
7 in	.13

Flats.

	cts. ℔s
2 to 9-16 in. wide by 2 to ⅝ thick	.8

Bessemer and O. H. Steel.

Bessemer Machinery	base price, 1 50
Open-hearth Tire	" 1 80
Open-hearth Spring	" 2 20
Sleigh Shoe	" 1 90
Toe Calk	" 2 10
Cutter Shoes, tapered and bent	" 2 20

English Tool Steel.

Jessop's	15½c
Hobson's "Best"	15½c
" "Choice"	35c

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	3 30
Bridge ½, ⅝, 11-16 and ¾ inch diam	3 00

Wrought Pipe and Boiler Tubes.

Lap weld black, base	dis. 65
Butt " " "	dis. 55
Lap " galv. "	dis. 52½
Butt " " "	dis. 50
Boiler tubes 2¼" and smaller	dis 62½
Boiler tubes 2½" and larger	dis. 65
Casing screw and socket joint	dis. 52½
Casing inserted joint	dis. 47½

MACHINERY SUPPLY MARKET.

Anvils.

American	℔ ℔ 9@10
Wright's	℔ ℔ 12

Bellows.

Blacksmiths' Hill's	dis 40
Blacksmiths' Bullock's	dis 50&10
Moulders'	dis 40@40&10
Hand	dis 40&10@50

Belting.

Boston Belting Co.'s standard	dis 70
" " " extra	dis 60&5
" " " best	dis 55
Cleveland Rubber Co. extra standard	dis 60&10
Hoyt's Short Lap	dis 45
Shultz Raw Hide Leather Belting, single,	dis 40
Munson's Short Lap Single Leather	dis 50
Munson's Short Lap Double and Light Double Leather	dis 50&10
Shultz Raw Hide Leather Belting, Double and Light Double	dis 4(
Standard, oak tanned	dis 50&1(
Alexander Brothers' pure oak tanned	dis

Blowers and Exhausters.

B. F. Sturtevant's	dis 20
Boston Blower Co.,	dis 35
Buffalo	dis 40

Chucks.

Cushman's 4 Jaw Independent	dis 45
" Combination	dis 40
" Geared Scroll	dis 30
" 2 Jaw Brass Workers	dis 30
" Drill	dis 35
Wescott's Scroll Combination	dis 33⅓
" Independent	dis 40
" Little Giant Drill	dis
Horton's Universal	dis
" Independent	dis 45
Whiton's Independent	dis 45
National Combination	dis 40
Sweetland "	dis 40
Almond Drill	dis 20
Morse "	dis 15
Skinner's Combination Lathe	dis 40&10
" Independent Lathe	dis 40&10
" Universal Lathe	dis 40&10
" Drill	dis 20

Cutters and Reamers.

Cleveland	dis 10@15
Pratt & Whitney	dis 10@15
Standard	dis 10@15
Morse	dis 15
Brown & Sharpe, Milling Cutters	dis 15
" " Gear Cutters	dis 15

Crowbars.

Cast Steel	℔ 3½
Iron, steel points	℔ lb 3

Drill and Drill Sockets.

Twist Drills	dis 50&10
Morse Taper and Straight Shank to 1½"	dis 50&10
Morse Taper and Straight Shank Larger than 1½"	dis 25
Drill Sockets	dis 25
Standard Twist Drills	dis 55@55&5
Cleveland " "	dis 55@55&5

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* Daily. † Daily, except Sunday.

FROM CLEVELAND TO	LEAVE	ARRIVE
Pittsburgh and Bellaire	† 7:00 am	†12:10 pm
Salem and Pittsburg	* 8:00 am	* 8:30 pm
Pittsburgh, Bellaire and East	†12:45 pm	† 6:25 pm
Philadelphia and New York	* 1:40 pm	*11:25 am
Baltimore and Washington	* 1:40 pm	*11:25 am
Alliance and Pittsburgh	* 1:40 pm	*11:25 am
Ravenna and Alliance	† 3:25 pm	† 9:50 am
Hudson and Ravenna	* 5:00 pm	* 8:25 am
Philadelphia and New York	*11:10 pm	* 5:25 am
Baltimore and Washington	*11:10 pm	* 5:25 am
Alliance and Pittsburgh	*11:10 pm	* 5:25 am

Mt. Vernon and Pan-Handle Route

FROM CLEVELAND TO	LEAVE	ARRIVE
Xenia and Cincinnati	* 8:40 am	* 5:15 pm
Akron and Columbus	* 8:40 am	*5:15 pm
Akron, Columbus & Zanesville	†12:45 pm	†12:10 pm
Akron and Orrville	† 3:25 pm	† 9.50 am
Columbus and Cincinnati	* 8:00 pm	* 6:55 am

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Depot foot of So. Water St. / City Office 137 Superior St.	Arrive.	Depart.
Valley Jctn. & Way Stations	*6:30 P M	*7:10 A M
Akron, Canton & Valley	*10:10 A M	*3:15 P M
Akron, Canton & Chicago	*8.10 A M	*6:30 P M
Akron, Canton & Wooster, Defiance, Garrett, Marietta, Wheeling, Washington, D. C., and Baltimore	†2:55 P M	†11:00 A M

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Good second-hand tubes bought.

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$2.50 CLEVELAND TO BUFFALO

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Commencing with opening of navigation (about April 1st). Magnificent side-wheel steel steamers

"State of Ohio" and "State of New York."

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SUNDAY INCLUDED.

Lv. Cleveland,	6:00 P.M.	Lv. Buffalo,	6:30 P.M.
Ar. Buffalo,	7:30 A.M.	Ar. Cleveland,	7:30 A.M.

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Take the "C. & B. Line" steamers and enjoy a refreshing night's rest when enroute to **Buffalo, Niagara Falls, Toronto, New York, Boston, Albany, 1,000 Islands,** or any Eastern or Canadian point.

Cheap Excursions Weekly to Niagara Falls.

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Chicago Heights Land Association
M. H. KILGALLEN, Gen'l Mgr. CHICAGO

Emery.

	No. 4 to No. 54 46 gr.	to Flour, C. F 150 gr.	F. FF.
Kegs, ℔	4½c	5 c	2½c
½ kegs ℔	4¾c	5¼c	2¾c
¼ kegs ℔	5 c	5½c	3 c
10 ℔ cans, 10 in case	6 c	6½c	5 c
10 ℔ cans less than 10	10 c	10 c	7½c

Emery Cloth and Paper.

Barder, Adamson & Co. ..... dis 50@50&5
H. H. Barton ..... dis 50@50&5

Emery Wheels.

Detroit ..... dis 60@70
Norton's ..... dis 60@70
Grant ..... dis 60@70
Sterling ..... dis 60@70
Celluloid ..... dis 10&33⅓
Northampton ..... dis 55
Crystal ..... dis 65@70
Vitrified ..... dis 60@70
Vulcanite ..... dis 60&10
Hamden ..... dis 60&10@70
Cyclone ..... dis 60@60&10

Files.

Arcade ..... dis 60&10@60&10&10
Nicholson ..... dis 60&10@60&10&10
" X. F. ..... dis 25
Kearney & Foot ..... dis 60&10@60&10&10
Black Diamond ..... dis 60&10@60&10&10
McClellan ..... dis 60&10@60&10&10
Disston's ..... dis 65@70
Western ..... dis 70
Stub's ..... dis 25
Grobet's ..... dis 30
Reynolds Bros.' Hand Cut ..... dis 50
Industry File Works Hand Cut ..... dis 50

Hammers.

P. S. W ..... dis 40
Atha new list, Jan. 15, 1887 ..... dis 50
Heavy hammers and sledges under 5 lbs. 12c
" " " " over 5 lbs. 10c

Jack Screws.

Illinois Bolt Co. list ..... dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¼	4	3½	3⅛
Hexagon	15½	11½	8½	6	5¼	5¼	
Washers	9	8	7	5	4½	4½	4⅛

In lots less than 100 lbs, ℔ add ¼c., 1 ℔ boxes add 1c to list.

Nails (wire).

List July 14, 1887 ..... dis 85
Standard Penny Nails, ℔ keg card rate
{ Car lots $2 30
{ Less than car lots $2.50

Oilers.

Zinc and Tin ..... dis 60
Brass and Copper ..... dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ℔ doz ..... dis 10@10&10

Picks.

Railroads, 5 to 6 lbs ..... $12 dis 60
" 6 to 7 lbs ..... $13 dis 60

Pulleys.

Iron Pulleys, Walker List ..... dis 50
Medart Pulleys ..... dis 50
Split Wood Pulleys ..... dis 55@60

Pulley Blocks.

Moore's Anti-Friction Differential Chain Pulley Block ..... dis 20

Rivets.

Iron, Thousand, list November 1, 1894 ..... dis 60@65
Iron, Ordinary, Cooper's Block and Carriage list November 1, 1894 ..... dis 60@65
Copper ..... dis 50@50&10

Taps.

Cards, Hand and Nut to 2 in ..... is 50
Carpenters' " " " ..... dis 50
Morse " " " ..... dis 50
Pratt & Whitney " " new list ..... dis 10
Machine Screw Taps ..... dis 55
Pipe Taps to 2½ in ..... dis 70
Stay Bolt Taps ..... dis 25
Stove Bolt Taps ..... dis 55
Pulley Taps ..... dis 40

Vises.

Solid Box ..... dis 60
Parker's ..... dis 20@25
Prentiss ..... dis 20
Stephen's ..... dis 25@30
Barrett's ..... dis 30
Miller's Falls ..... dis 40
Merrill's ..... dis 15@20
Howard ..... dis 35

Wire.

New List, Apr. 9, 1894

Brass ..... dis 4c
Copper ..... dis 4c
Bright and annealed, Nos. 0@18 ..... dis 70&10@75
" " Nos. 19@26 ..... dis 75@75& 5
" " Nos. 27@36 ..... dis 75&10& 5
Coppered Nos. 0 to 18, market list ..... dis 70@70& 5
Galvanized Nos. 0 to 18 " ..... dis65& 5
Tinned market Nos. 0 to 18 ..... dis 67½
Cast steel ..... dis 50
Tinned Broom Wire ..... dis 70&5@70&10
Annealed Fence, Nos. 8 and 9 ..... dis 75
Annealed Grape, Nos. 10 to 14 ..... dis 75
Stub's Steel Wire regular ..... 95c ℔ dis 30

Wrenches.

Coe's genuine ..... dis 50
Girard Standard ..... dis 70&10
Agricultural ..... dis 75&10
Mechanic's ..... dis 55&10& 5
Bemis & Call's Combination ..... dis 35
Donohue's Engineers ..... dis 20&10
Lamson & Sessions Engineers ..... dis 60
Billings & Spencer's Drop Forged ..... dis 25
William's " " ..... dis 25
Alligator " " ..... dis 40

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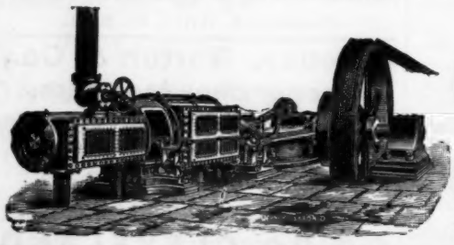

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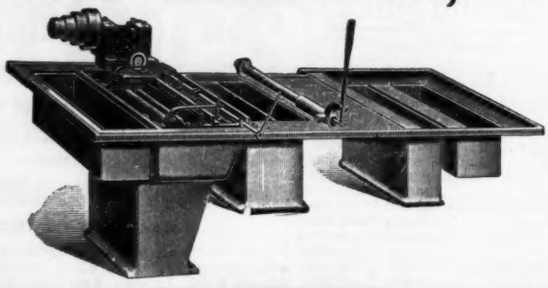

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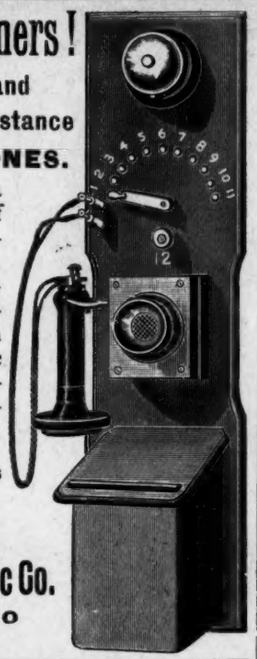

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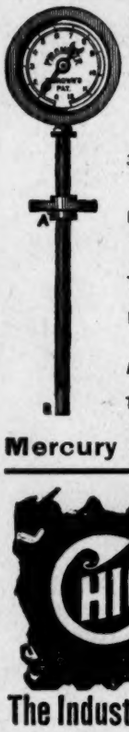

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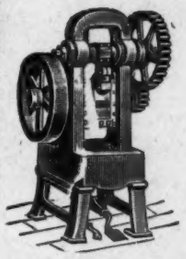

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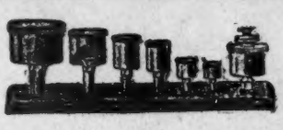

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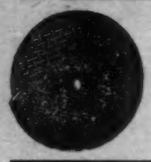

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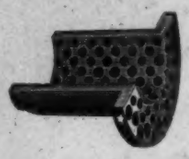

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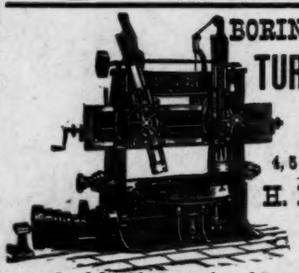

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